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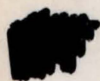
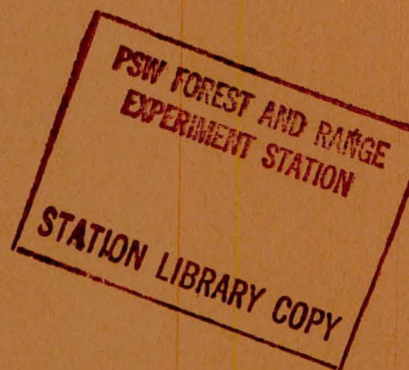
(NBD)

MANUAL NETWORK ANALYSIS METHOD  
FOR TIMBER SALES  
REVISED

By  
Ronald Tangemen  
and  
Clyde Weller

August ~~1978~~ 1979

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R-3

REPLY TO: 7710 Transportation Planning  
2430 Commercial Timber Sales

July 3, 1979

SUBJECT: Manual Network Analysis Method  
for Timber Sales (Update)

TO: All Forest Supervisors



Enclosed are revised pages 43-51 and 53-56 to the Manual Network Analysis Method of Timber Sales (Revised) by Tangeman and Weller, August 1978.

The new Table 3, Round Trip Haul Cost for "On-Highway" Logging Trucks, pages 43-47, is based on the current estimated rate of \$35 per hour for logging truck, trailer, and operator. This rate is based on information supplied by the publishers of the "Construction Equipment Cost Reference Guide."

Road Maintenance, pages 48-51, is revised to include current operator, laborer, material, and equipment rates based on the R-3 Cost Guide.

Table 6 and Table 7, pages 53-56, are revised to facilitate calculations for maintenance and network appraisals, and to correct errors.

To calculate delay costs as exemplified on page 27 of the text, use \$21 per hour for a resultant delay cost of:

$$\frac{13.63 \text{ minutes}}{\text{MBF}} \times \frac{\$21}{\text{hour}} \times \frac{1 \text{ hour}}{60 \text{ minutes}} = \frac{\$4.77}{\text{MBF}}$$

PAUL N. WEAVER  
Acting Regional Engineer

Enclosures

cc: Regional Transportation Planners

UNITED STATES DEPARTMENT OF AGRICULTURE  
FOREST SERVICE

R-3

REPLY TO: 7710 Transportation Planning  
(2420) Timber Appraisals

September 25, 1978

SUBJECT: Manual Network Analysis Haul Costs  
and Maintenance Costs

TO: Forest Supervisors



Engineering, in cooperation with Timber Management, has incorporated a maintenance cost estimating portion to the Manual Network Analysis Method.

Now, haul costs and maintenance costs will be appraised for transportation planning and timber sale appraisals using the Manual Network Analysis Method by Clyde Weller.

The haul costs (TABLE 3) have also been updated to \$31.00 per hour to comply with current ownership rates. The delay time cost does not have to be changed from the existing \$20.00 per hour (\$4.54/MBF).

An Appendix for Maintenance has been added to the text starting with page 48.

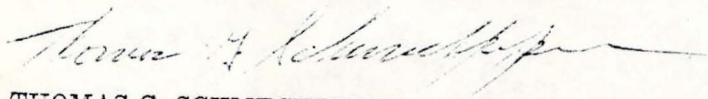
TABLE 4 remains unchanged. TABLE 4A has been added to offer reasonable current cost ranges for Forest Service Maintenance Items (Purchaser Required Deposits) and Purchaser Maintenance (both exclude overhead).

TABLE 5 AGGREGATE WEAR FACTORS lists differing surface materials and average wear factors. These should be used for surface replacement calculations.

TABLE 6 ROAD MAINTENANCE WORKSHEET was established to facilitate calculations of maintenance cost for CWFS (deposits) and purchaser maintenance. Maintenance deposits for future work should be estimated to the time of the planned work. District, SO, RO and WO overhead must be included in these estimates for deposits. An explanation of each column follows on the back of TABLE 6.

TABLE 7 NETWORK COST APPRAISAL is a handy form for calculating haul costs and accumulating haul, maintenance, and construction costs.

We suggest that TABLE 6 and TABLE 7 be part of the Timber Sale Appraisal.

  
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Deputy Regional Forester

cc: C. Weller ✓  
Timber Management (3)  
P. Weaver  
R. Van Natta

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## I. INTRODUCTION

The following is a step by step description of a hand network analysis method of determining efficient sale to mill haul routes.

In order to determine the most efficient route, it is necessary to analyze the road system available for log haul, looking at feasible haul routes (usually not more than 4 or 5 and sometimes less will be available). The route that intuitively seems the best is not always the most efficient.

For log haul, efficiency can be expressed in terms of distance, haul time and cost. The shortest sale to mill route is not necessarily the fastest or the least expensive, nor may using the road in the present condition be the least expensive alternate. Therefore, it is desirable to analyze the haul system from all three standpoints, so the decision maker will have adequate information on which to decide which route should be chosen as the "appraisal route" and programmed for any necessary construction or reconstruction.

This analysis should be conducted by the Forest Timber and Engineering Staff working together as a team. A satisfactory analysis is not likely to be obtained by either, or both, working independently.

A systems analysis should begin at the stump and end at the mill. Therefore, the logging system, temporary roads and local system roads, distances, times, and costs must be analyzed together for all possible routes for transporting the timber to the mill or appraisal point.

In conjunction with this guide a logging sale road density versus skidding distance guide will be forth coming to help coordinate the entire system from the stump to the mill.

## II. PROCEDURE

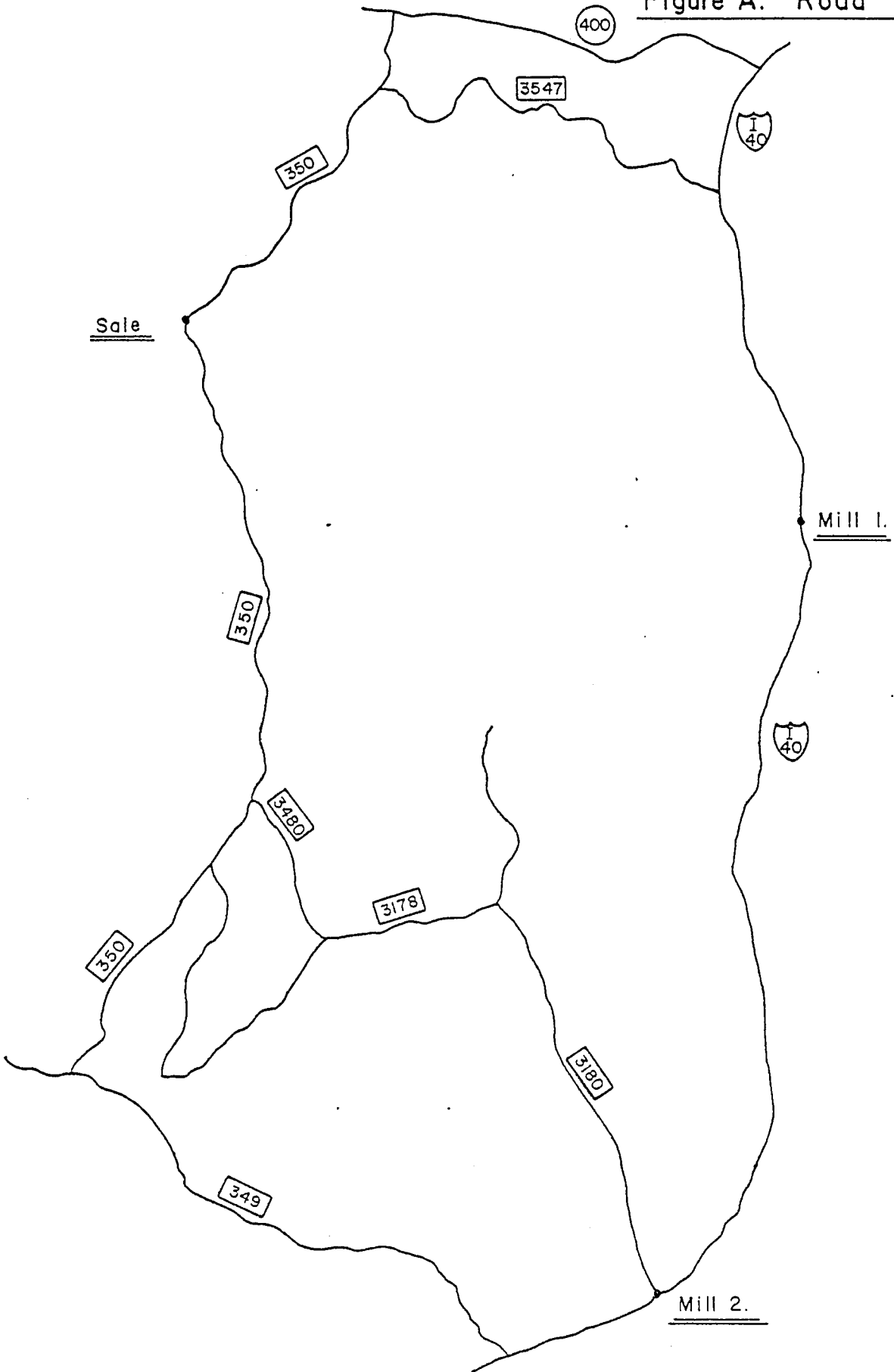
### A. Road System

Figure A shows all the roads on the existing system that could be used to haul timber from the Sale to Mills 1 & 2.

### B-1. Road Network

The road system is described as a network when it is broken into a series of connected segments called links. Links are joined at numbered points called nodes.

Figure A. Road System



A link is a section of road with reasonably uniform characteristics of width (number of lanes), surface type, horizontal alignment, and range of grade. More than one link may exist between intersections when changes in the above characteristics occur (eg. surface changes from paved to gravel or width changes from 2 lanes to 1 lane or major grade changes).

In figure B-1. Start of Network Schematic, nodes 1, 2, and 3 break the section of road from the Sale to the intersection of roads 350 and 3547 into four one way links 1 to 2, 2 to 1, 2 to 3, and 3 to 2. Node number 2 in this case is a change of road type from primitive to graded and drained. Links start and stop at nodes which are used to identify the direction of travel on links.

Links start and stop at nodes which are used to identify the direction of travel on links.

For example, in Figure B-2 Road Network Schematic, link 8-15 means traveling from node 8 to node 15 and link 15-8 from node 15 to node 8. Nodes occur where two or more links join, and in some cases at the unconnected end of a link where some activity such as a timber sale takes place. Arrows indicate the direction of travel along links. Figure B-2 Road Network Schematic is a completed network of possible routes from the Sale to the two mills.

#### C-1. Haul Class Determination

Each link in the road network has characteristics of width, surface type, horizontal alignment, and grade range which determine the operating speed and cost of a logging truck as it passes over that link. A separate number called the haul class is assigned to each unique combination of the four characteristics. The haul class is used to determine haul time and cost for the link during analysis.

Figure C-1. Haul Class Inventory Data shows the form suggested for inventorying the characteristics of road width, surface type, horizontal alignment and grade range in preparation for determining the haul classes.

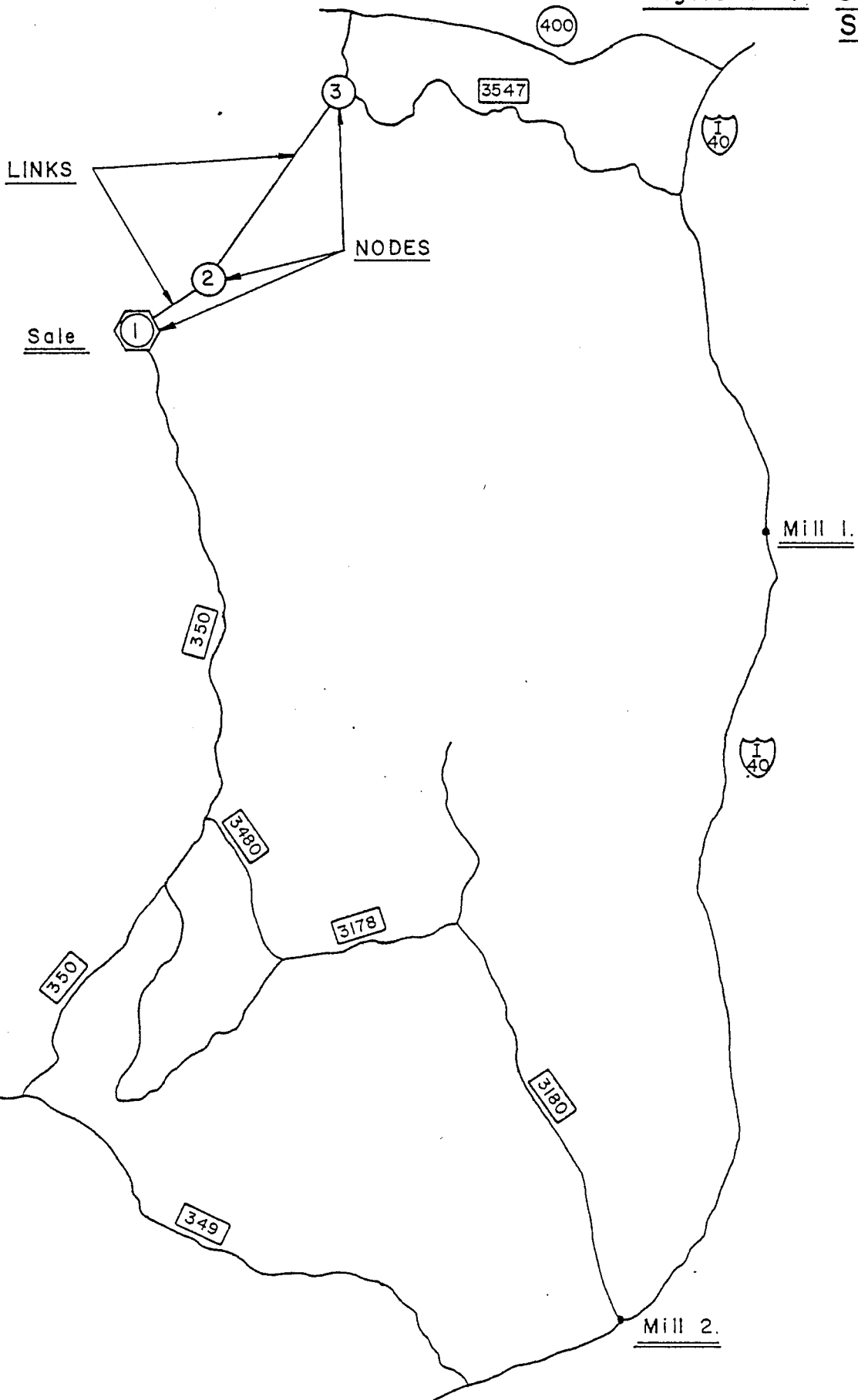
#### C-2. Haul Classes

Once existing link characteristics are inventoried, the existing haul class can be determined for each link. The use of Table 1. Haul Classes (See Appendix) for this purpose is demonstrated in

NOTE: Primitive alignment indicates alignment which is not passable by a logging truck (usually less than 50 feet radius curves). Haul Classes 281-288 and 313-320 are of primitive alignment. Primitive surface (Haul Classes 289-320) may be impassable to logging trucks or highly destructive to operators and maintenance without reconstruction. It may prove to be economical to haul over these classes of roads without reconstruction for very short distances or for very little timber.

Figure B-1. Start of Network Schematic

4



5

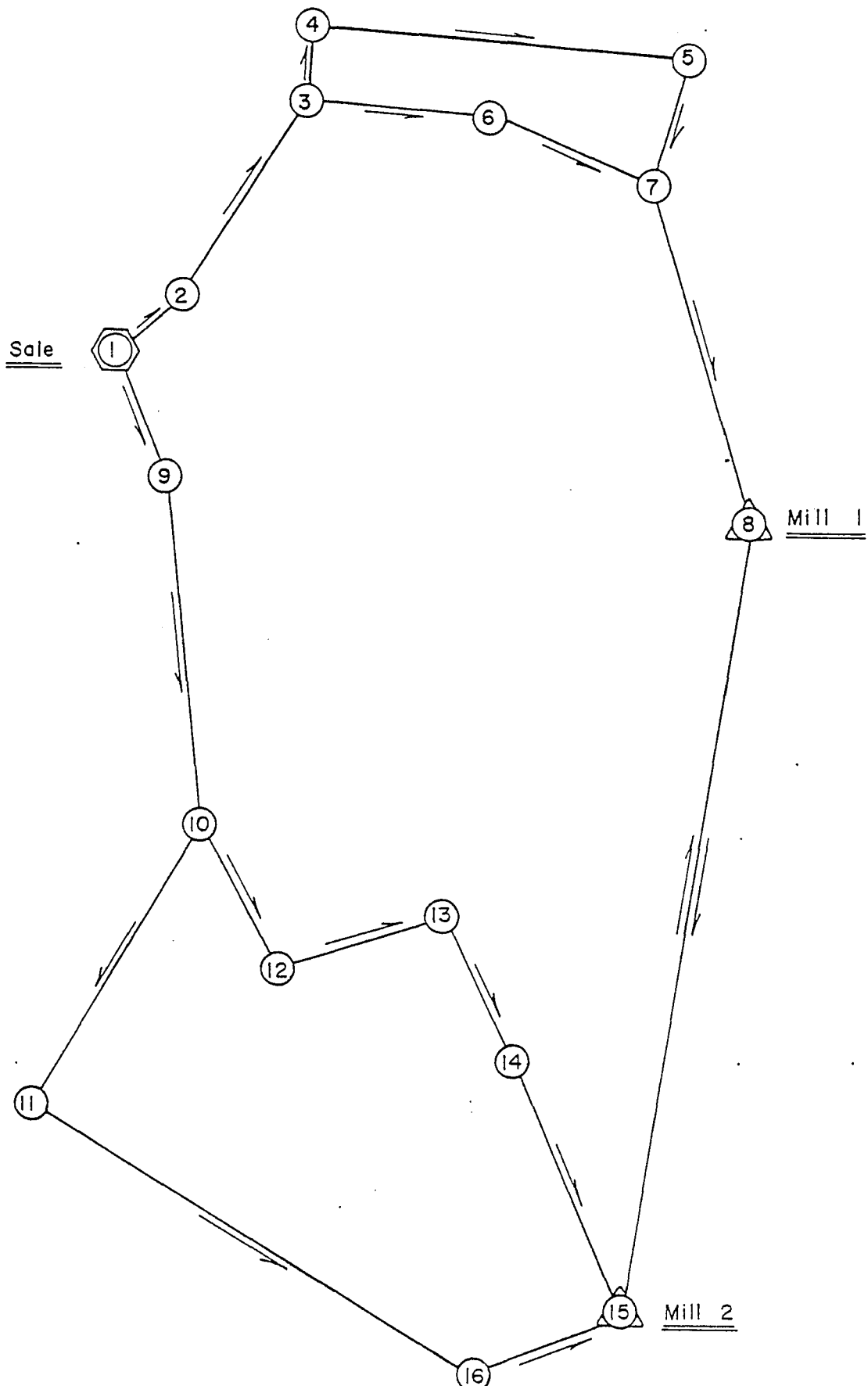


Figure C-1. Haul Class Inventory Data

| Link                 | Road No. | Length (Miles) | No. of Lanes | Road Surface    | Horizontal Alignment | Average Grade Range |
|----------------------|----------|----------------|--------------|-----------------|----------------------|---------------------|
| Haul North from Sale |          |                |              |                 |                      |                     |
| 1-2                  | 350      | 2.8            | 1            | (D-1) Primitive | E-Primitive          | + 0-4 %             |
| 2-3                  | "        | 7.3            | 1            | (C-1) G & D     | C - Fair             | +0-4 %              |
| 3-4                  | "        | 2.3            | 1            | (B-2) Gravel    | C - Fair             | +0-4 %              |
| 3-6                  | 3547     | 6.3            | 1            | (C-1) G & D     | C - Fair             | + 7-10%             |
| 4-5                  | SR-400   | 12.0           | 2            | (A-2) Paved     | B - Good             | - 0-4 %             |
| 5-7                  | I-40     | 4.0            | 4            | (A-1) Paved     | A-Excellent          | +0-4 %              |
| 5-7                  | 3547     | 5.6            | 1            | (B-1) Gravel    | B-Good               | - 4-7%              |
| 7-8                  | I-40     | 11.0           | 4            | (A-1) Paved     | A-Excellent          | -0-4 %              |
| 8-15                 | II       | 25.5           | 4            | (A-1) Paved     | A-Excellent          | -0-4 %              |
| Haul South from Sale |          |                |              |                 |                      |                     |
| 1-9                  | 350      | 4.4            | 1            | (D-1) Primitive | E-Primitive          | + 4-7 %             |
| 9-10                 | "        | 11.4           | 1            | (C-2) G & D     | D - Poor             | +0-4 %              |
| 10-11                | "        | 11.5           | 1            | (C-1) G & D     | C - Fair             | - 0-4 %             |
| 10-12                | 3480     | 5.2            | 1            | (C-2) G & D     | D - Poor             | +0-4 %              |
| 11-16                | 349      | 17.0           | 1            | (C-1) G & D     | C - Fair             | - 0-4 %             |
| 12-13                | 3178     | 5.5            | 2            | (B-1) Gravel    | B-Good               | -4-7%               |
| 13-14                | 3180     | 5.1            | 1            | (C-2) G&D       | D-Poor               | +4-7%               |
| 14-15                | "        | 8.9            | 1            | (C-1) G & D     | C - Fair             | - 0-4 %             |
| 15-8                 | I-40     | 25.5           | 4            | (A-1) Paved     | A-Excellent          | +0-4 %              |
| 16-15                | "        | 5.0            | 4            | (A-1) Paved     | A-Excellent          | +0-4 %              |

Figure C-2. Use of Table 1. Haul Classes using link 1-2 as an example.

Link 1-2 is a 1 lane road with primitive surface and horizontal alignment, with an average grade in the +0-4% range. This gives the link a haul class of 314 which is recorded on the inventory forms as shown in Figure C-3.0. Haul Class Inventory Documentation. Haul classes for all links in the network are determined and recorded in this manner using the classes shown in Table 1 or the Appendix.

### C-3.1. Minimum Standard Haul Classes

The minimum standard for a haul road is normally a one lane road with road surface class C (Graded & Drained) and horizontal alignment class D (Poor alignment). Roads should be evaluated for possible economical use without reconstruction. Very short terminal facilities or facilities over which very small volumes of timber are to be hauled can be utilized economically without reconstruction. See figure C.3.1 Haul Class Inventory Documentation. On two links, 1-2 and 1-9, both the road surface and horizontal alignment classes do not meet these minimum standards. Therefore link 1-2 would have to be reconstructed from Haul Class 314 to 274 and link 1-9 from Haul Class 316 to 276 to bring them to minimum standards before they could be used as part of a log haul route.

### C-3.2. Completed Inventory and Determination of Haul Classes.

The classes shown in the "Min. Std. Haul Classes" column of Figure C-3.2. are used for the log haul analysis. This column will enumerate where roads are adequate and where roads would require reconstruction. Figure C-4. shows the haul classes in map form. The minimum haul classes are shown with below standard roads indicated in (Parentheses).

See Figure C-4. Haul Class Schematic for a schematic representation of this Haul Class Inventory chart. Note: Link 8-15 has a different Haul Class than link 15-8, due to the difference in grade.

## D. Haul Distance Computation

### Step D-1. - Distance

Show length of each link on the Haul Network (Lengths from Column 3 of Figure C-3.2). Figure D-1. Haul Distances exemplifies the procedure.

TABLE 1.- HAUL CLASSES

## HAUL CLASSES

| No.<br>Lanes | Road<br>Surface                 | Horizontal<br>Alignment | Average Grade in Direction of Haul |      |     |     |                       |     |      |     |
|--------------|---------------------------------|-------------------------|------------------------------------|------|-----|-----|-----------------------|-----|------|-----|
|              |                                 |                         | % Adverse Grade (+)                |      |     |     | % Favorable Grade (-) |     |      |     |
|              |                                 |                         | >10                                | 10-7 | 7-4 | 4-0 | 0-4                   | 4-7 | 7-10 | >10 |
| 2            | -A-<br>Paved                    | A-Excellent             | 8                                  | 6    | 4   | 2   | 7                     | 3   | 5    | 7   |
|              |                                 | B-Good                  | 16                                 | 14   | 12  | 0   | 9                     | 11  | 13   | 15  |
|              |                                 | C-Fair                  | 24                                 | 22   | 20  | 8   | 17                    | 19  | 21   | 23  |
|              |                                 | D-Poor                  | 32                                 | 30   | 28  | 6   | 25                    | 27  | 29   | 31  |
|              | -B-<br>Gravel                   | A-Excellent             | 40                                 | 38   | 36  | 4   | 33                    | 35  | 37   | 39  |
|              |                                 | B-Good                  | 48                                 | 46   | 44  | 2   | 41                    | 43  | 45   | 47  |
|              |                                 | C-Fair                  | 56                                 | 54   | 52  | 0   | 49                    | 51  | 53   | 55  |
|              |                                 | D-Poor                  | 64                                 | 62   | 60  | 8   | 57                    | 59  | 61   | 63  |
|              | -C-<br>Graded<br>and<br>Drained | E-Excellent             | 72                                 | 70   | 68  | 6   | 65                    | 67  | 69   | 71  |
|              |                                 | B-Good                  | 80                                 | 78   | 76  | 4   | 73                    | 75  | 77   | 79  |
|              |                                 | C-Fair                  | 88                                 | 86   | 84  | 2   | 81                    | 83  | 85   | 87  |
|              |                                 | D-Poor                  | 96                                 | 94   | 92  | 0   | 89                    | 91  | 93   | 95  |
| 1 1/2        | -A-<br>Paved                    | A-Excellent             | 104                                | 102  | 100 | 8   | 97                    | 99  | 101  | 103 |
|              |                                 | B-Good                  | 112                                | 110  | 108 | 6   | 105                   | 107 | 109  | 111 |
|              |                                 | C-Fair                  | 120                                | 118  | 116 | 4   | 113                   | 115 | 117  | 119 |
|              |                                 | D-Poor                  | 128                                | 126  | 124 | 2   | 121                   | 123 | 125  | 127 |
|              | -B-<br>Gravel                   | A-Excellent             | 136                                | 134  | 132 | 0   | 129                   | 131 | 133  | 135 |
|              |                                 | B-Good                  | 144                                | 142  | 140 | 8   | 137                   | 139 | 141  | 143 |
|              |                                 | C-Fair                  | 152                                | 150  | 148 | 6   | 145                   | 147 | 149  | 151 |
|              |                                 | D-Poor                  | 160                                | 158  | 156 | 4   | 153                   | 155 | 157  | 159 |
|              | -C-<br>Graded<br>and<br>Drained | A-Excellent             | 168                                | 166  | 164 | 2   | 161                   | 163 | 165  | 167 |
|              |                                 | B-Good                  | 176                                | 174  | 172 | 0   | 169                   | 171 | 173  | 175 |
|              |                                 | C-Fair                  | 184                                | 182  | 180 | 8   | 177                   | 179 | 181  | 183 |
|              |                                 | D-Poor                  | 192                                | 190  | 188 | 6   | 185                   | 187 | 189  | 191 |
| 1            | -A-<br>Paved                    | A-Excellent             | 200                                | 198  | 196 | 4   | 193                   | 195 | 197  | 199 |
|              |                                 | B-Good                  | 208                                | 206  | 204 | 2   | 201                   | 203 | 205  | 207 |
|              |                                 | C-Fair                  | 216                                | 214  | 212 | 0   | 209                   | 211 | 213  | 215 |
|              |                                 | D-Poor                  | 224                                | 222  | 220 | 8   | 217                   | 219 | 221  | 223 |
|              | -B-<br>Gravel                   | A-Excellent             | 232                                | 230  | 228 | 6   | 225                   | 227 | 229  | 231 |
|              |                                 | B-Good                  | 240                                | 238  | 236 | 4   | 233                   | 235 | 237  | 239 |
|              |                                 | C-Fair                  | 248                                | 246  | 244 | 2   | 241                   | 243 | 245  | 247 |
|              |                                 | D-Poor                  | 256                                | 254  | 252 | 0   | 249                   | 251 | 253  | 255 |
|              | -C-<br>Graded<br>and<br>Drained | B-Good                  | 264                                | 262  | 260 | 8   | 257                   | 259 | 261  | 263 |
|              |                                 | C-Fair                  | 272                                | 270  | 268 | 6   | 265                   | 267 | 269  | 271 |
|              |                                 | D-Poor                  | 280                                | 278  | 276 | 4   | 273                   | 275 | 277  | 279 |
|              |                                 | E-Primitive             | 288                                | 286  | 284 | 2   | 281                   | 283 | 285  | 287 |
|              | -D-<br>Primitive                | B-Good                  | 296                                | 294  | 292 | 0   | 289                   | 291 | 293  | 295 |
|              |                                 | C-Fair                  | 304                                | 302  | 300 | 8   | 297                   | 299 | 301  | 303 |
|              |                                 | D-Poor                  | 312                                | 310  | 308 | 6   | 305                   | 307 | 309  | 311 |
|              |                                 | E-Primitive             | 320                                | 318  | 316 | 4   | 313                   | 315 | 317  | 319 |

Alignment

K

Excellent

 $K > 100$ 

Good

 $50 < K \leq 100$ 

Fair

 $20 < K \leq 50$ 

Poor

 $10 < K \leq 20$ 

Primitive

 $K \leq 10$ 

$$K = \frac{\bar{R}}{N}$$

 $\bar{R}$ : Average radius of curvature between nodes

N: Number of curves / mile between nodes

NOTE: Logging truck can not negotiate primitive alignment

Figure C-3.0. Haul Class Inventory Documentation

| Link                 | Road No. | Length (Miles) | No. of Lanes | Road Surface    | Horizontal Alignment | Average Grade Range | Existing Haul Class |
|----------------------|----------|----------------|--------------|-----------------|----------------------|---------------------|---------------------|
| Haul North from Sale |          |                |              |                 |                      |                     |                     |
| 1-2                  | 350      | 2.8            | 1            | (D-1) Primitive | E-Primitive          | +0-4%               | 314                 |
| 2-3                  | "        | 7.3            | 1            | (C-1) G & D     | C-Fair               | +0-4%               |                     |
| 3-4                  | "        | 2.3            | 1            | (B-2) Gravel    | C-Fair               | +0-4%               |                     |
| 3-6                  | 3547     | 6.3            | 1            | (C-1) G & D     | C-Fair               | +7-10%              |                     |
| 4-5                  | SR-400   | 12.0           | 2            | (A-2) Paved     | B-Good               | -0-4%               |                     |
| 5-7                  | I-40     | 4.0            | 4            | (A-1) Paved     | A-Excellent          | +0-4%               |                     |
| 6-7                  | 3547     | 5.6            | 1            | (B-1) Gravel    | B-Good               | -4-7%               |                     |
| 7-8                  | I-40     | 11.0           | 4            | (A-1) Paved     | A-Excellent          | -0-4%               |                     |
| 8-15                 | "        | 25.5           | 4            | (A-1) Paved     | A-Excellent          | -0-4%               |                     |
| Haul South from Sale |          |                |              |                 |                      |                     |                     |
| 1-9                  | 350      | 4.4            | 1            | (D-1) Primitive | E-Primitive          | +4-7%               |                     |
| 9-10                 | "        | 11.4           | 1            | (C-2) G & D     | D-Poor               | +0-4%               |                     |
| 10-11                | "        | 11.5           | 1            | (C-1) G & D     | C-Fair               | -0-4%               |                     |
| 10-12                | 3480     | 5.2            | 1            | (C-2) G & D     | D-Poor               | +0-4%               |                     |
| 11-16                | 349      | 17.0           | 1            | (C-1) G & D     | C-Fair               | -0-4%               |                     |
| 12-13                | 3178     | 5.5            | 2            | (B-1) Gravel    | B-Good               | -4-7%               |                     |
| 13-14                | 3180     | 5.1            | 1            | (C-2) G & D     | D-Poor               | +4-7%               |                     |
| 14-15                | "        | 8.9            | 1            | (C-1) G & D     | C-Fair               | -0-4%               |                     |
| 15-8                 | I-40     | 25.5           | 4            | (A-1) Paved     | A-Excellent          | +0-4%               |                     |
| 16-15                | "        | 5.0            | 4            | (A-1) Paved     | A-Excellent          | +0-4%               |                     |

Figure C-3.1. Minimum Haul Class Inventory Documentation

| Link                 | Road No. | Length (Miles) | No. of Lanes | Road Surface    | Horizontal Alignment | Average Grade Range | Existing Haul Class | Min. Sta. Haul Class |
|----------------------|----------|----------------|--------------|-----------------|----------------------|---------------------|---------------------|----------------------|
| Haul North from Sale |          |                |              |                 |                      |                     |                     |                      |
| 1-2                  | 350      | 2.8            | 1            | (D-1) Primitive | E - Primitive        | +0-4%               | 314                 | 274                  |
| 2-3                  | "        | 7.3            | 1            | (C-1) G & D     | C - Fair             | +0-4%               | 266                 |                      |
| 3-4                  | "        | 2.3            | 1            | (B-2) Gravel    | C - Fair             | +0-4%               | 242                 |                      |
| 3-6                  | 3547     | 6.3            | 1            | (C-1) G & D     | C - Fair             | +7-10%              | 270                 |                      |
| 4-5                  | SR-400   | 12.0           | 2            | (A-2) Paved     | B - Good             | -0-4%               | 9                   |                      |
| 5-7                  | I-40     | 4.0            | 4            | (A-1) Paved     | A - Excellent        | +0-4%               | 2                   |                      |
| 6-7                  | 3547     | 5.6            | 1            | (B-1) Gravel    | B - Good             | -4-7%               | 235                 |                      |
| 7-8                  | I-40     | 11.0           | 4            | (A-1) Paved     | A - Excellent        | -0-4%               | 1                   |                      |
| 8-15                 | "        | 25.5           | 4            | (A-1) Paved     | A - Excellent        | -0-4%               | 1                   |                      |
| Haul South from Sale |          |                |              |                 |                      |                     |                     |                      |
| 1-9                  | 350      | 4.4            | 1            | (D-1) Primitive | E - Primitive        | +4-7%               | 316                 | 276                  |
| 9-10                 | "        | 11.4           | 1            | (C-2) G & D     | D - Poor             | +0-4%               | 274                 |                      |
| 10-11                | "        | 11.5           | 1            | (C-1) G & D     | C - Fair             | -0-4%               | 265                 |                      |
| 10-12                | 3480     | 5.2            | 1            | (C-2) G & D     | D - Poor             | +0-4%               | 274                 |                      |
| 11-16                | 349      | 17.0           | 1            | (C-1) G & D     | C - Fair             | -0-4%               | 265                 |                      |
| 12-13                | 3178     | 5.5            | 2            | (B-1) Gravel    | B - Good             | -4-7%               | 43                  |                      |
| 13-14                | 3180     | 5.1            | 1            | (C-2) G & D     | D - Poor             | +4-7%               | 276                 |                      |
| 14-15                | "        | 8.9            | 1            | (C-1) G & D     | C - Fair             | -0-4%               | 265                 |                      |
| 15-8                 | I-40     | 25.5           | 4            | (A-1) Paved     | A - Excellent        | +0-4%               | 2                   |                      |
| 16-15                | "        | 5.0            | 4            | (A-1) Paved     | A - Excellent        | +0-4%               | 2                   |                      |

Figure C-3.2. Haul Class Inventory

| Link                 | Road No. | Length (Miles) | No. of Lanes | Road Surface    | Horizontal Alignment | Average Grade Range | Existing Haul Class | Min. Sta. Haul Class |
|----------------------|----------|----------------|--------------|-----------------|----------------------|---------------------|---------------------|----------------------|
| Haul North from Sale |          |                |              |                 |                      |                     |                     |                      |
| 1-2                  | 350      | 2.8            | 1            | (D-1) Primitive | E-Primitive          | +0-4%               | 314                 | 274                  |
| 2-3                  | "        | 7.3            | 1            | (C-1) G & D     | C-Fair               | +0-4%               | 266                 | 266                  |
| 3-4                  | "        | 2.3            | 1            | (B-2) Gravel    | C-Fair               | +0-4%               | 242                 | 242                  |
| 3-6                  | 3547     | 6.3            | 1            | (C-1) G & D     | C-Fair               | +7-10%              | 270                 | 270                  |
| 4-5                  | SH-400   | 12.0           | 2            | (A-2) Paved     | B-Good               | -0-4%               | 9                   | 9                    |
| 5-7                  | I-40     | 4.0            | 4            | (A-1) Paved     | A-Excellent          | +0-4%               | 2                   | 2                    |
| 6-7                  | 3547     | 5.6            | 1            | (B-1) Gravel    | B-Good               | -4-7%               | 235                 | 235                  |
| 7-8                  | I-40     | 11.0           | 4            | (A-1) Paved     | A-Excellent          | -0-4%               | 1                   | 1                    |
| 8-15                 | "        | 25.5           | 4            | (A-1) Paved     | A-Excellent          | -0-4%               | 1                   | 1                    |
| Haul South from Sale |          |                |              |                 |                      |                     |                     |                      |
| 1-9                  | 350      | 4.4            | 1            | (D-1) Primitive | E-Primitive          | +4-7%               | 316                 | 276                  |
| 9-10                 | "        | 11.4           | 1            | (C-2) G & D     | D-Poor               | +0-4%               | 274                 | 274                  |
| 10-11                | "        | 11.5           | 1            | (C-1) G & D     | C-Fair               | -0-4%               | 265                 | 265                  |
| 10-12                | 3480     | 5.2            | 1            | (C-2) G & D     | D-Poor               | +0-4%               | 274                 | 274                  |
| 11-16                | 349      | 17.0           | 1            | (C-1) G & D     | C-Fair               | -0-4%               | 265                 | 265                  |
| 12-13                | 3178     | 5.5            | 2            | (B-1) Gravel    | B-Good               | -4-7%               | 43                  | 43                   |
| 13-14                | 3180     | 5.1            | 1            | (C-2) G & D     | D-Poor               | +4-7%               | 276                 | 276                  |
| 14-15                | "        | 8.9            | 1            | (C-1) G & D     | C-Fair               | -0-4%               | 265                 | 265                  |
| 15-8                 | I-40     | 25-5           | 4            | (A-1) Paved     | A-Excellent          | +0-4%               | 2                   | 2                    |
| 16-15                | "        | 5.0            | 4            | (A-1) Paved     | A-Excellent          | +0-4%               | 2                   | 2                    |

Figure C-4. Haul Class Schematic

Haul Classes

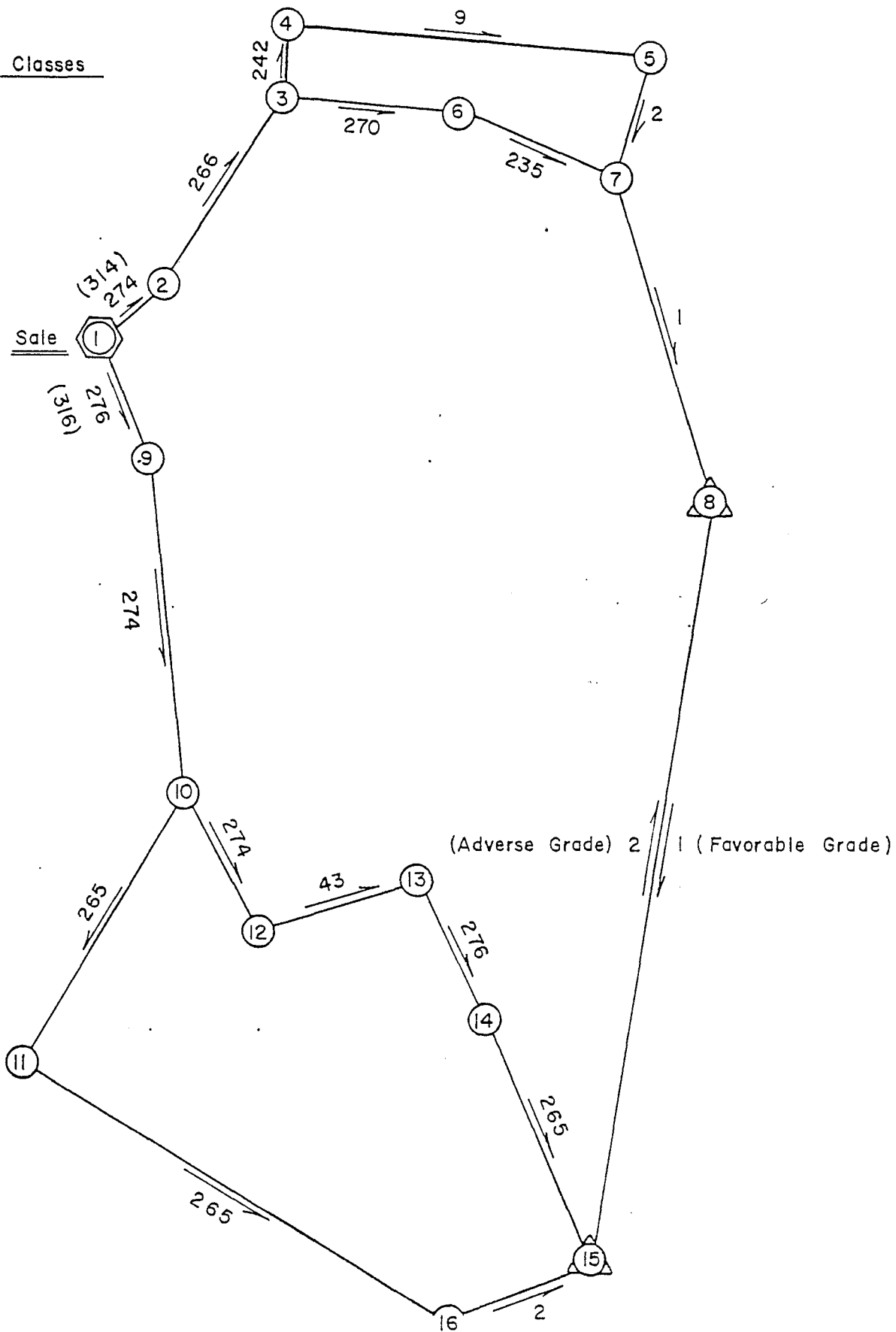
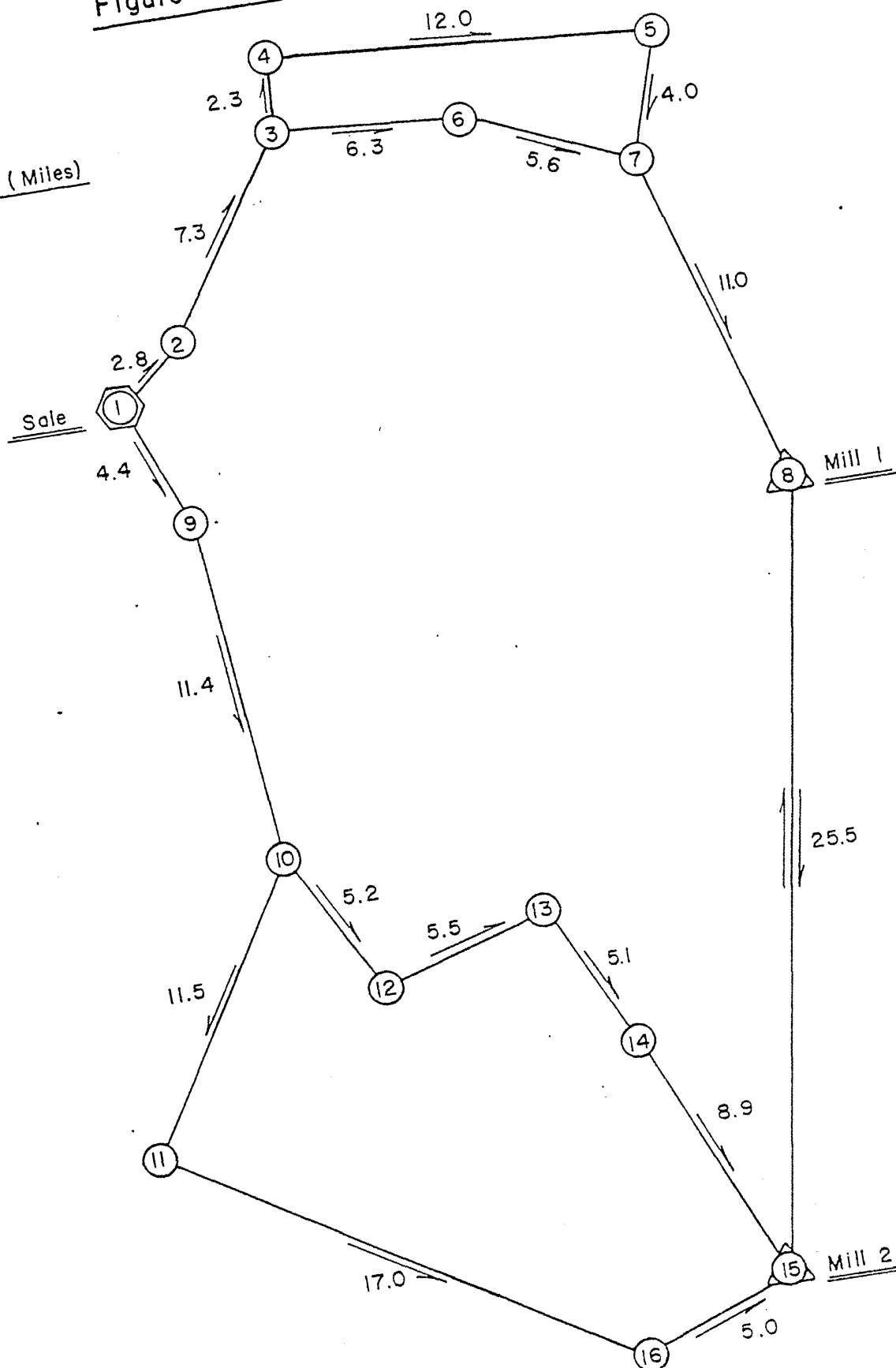


Figure D-1. Haul Distances

Distance (Miles)



### Step D-2.

Starting at the Sale and proceeding towards the mill begin adding the length of the individual links so that each node shows in brackets the distance from the sale to that node. See Figure D-2. Haul Distance Calculations Distance from sale at node 1 to Junction at node 3 is (10.1) miles. Work One Direction At A Time.

### Step D-3.

Between Nodes 3 and 7, two routes are possible.

Proceed as in Step 2 working along each route. (See Figure D3) Distance from Sale to Node 5 is (24.4) miles and Distance from Sale to Node 6 is (16.4) miles.

### Step D-4.

The two routes will come together at Node 7. Therefore, it is necessary at this point to label the routes so that you can identify the distance along each route from the sale to the two mills.

Distance from the Sale to Node 7 is 28.4 miles along Route A, shown as (A, 28.4), and 22.0 miles along Route B, shown as (B, 22). (See Figure D-4). Distance to Mill 1 is 39.4 miles along Route A and 33.0 miles along Route B.

### Step D-5.

Continue to Mill 2. In this example, we are analyzing four possible haul routes to two mills to find the most efficient haul route for the sale. Note that the route A and B continued from Mill 1 to Mill 2 is obviously not the fastest appraisal route but may be the fastest route to Mill 2. (See Figure D-5).

A table of haul distances from the sale to the two mills over the four possible haul routes will aid in selecting the most efficient route to each mill.

### Step D-6.

Calculate the Distance from the Sale to both mills along Route C as outlined in steps D-2. through D-5.

Next calculate the distance from the sale of both mills along Route D. Start with link 10 to 11 since distance to Node 10 was calculated above. See Figure D-6. Completed Haul Distances.

This completes the analysis for distance. The shortest haul route to Mill 1 is Route B, 33.0 miles. The shortest haul to Mill 2 is

Figure D-2. Haul Distance Calculations

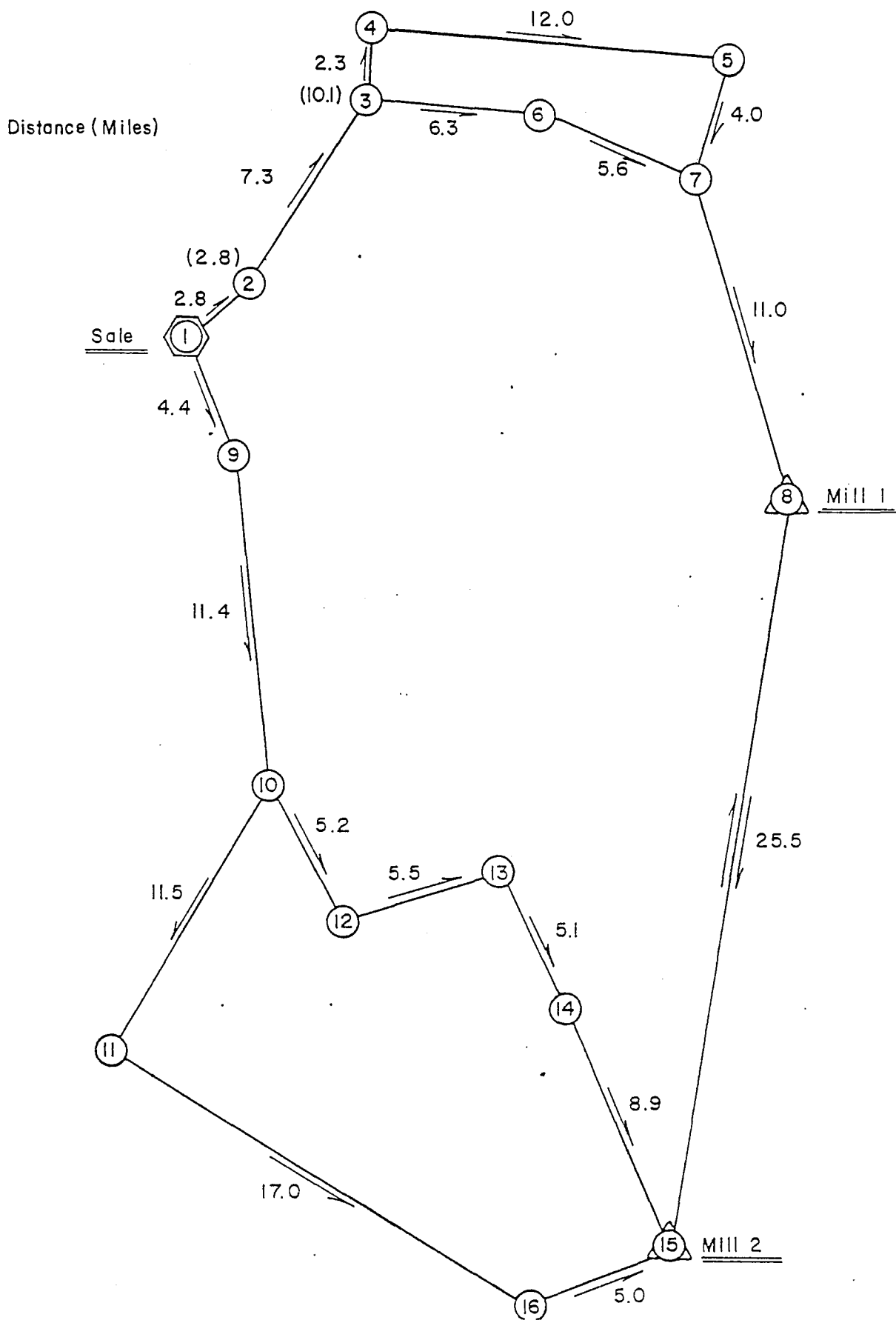


Figure D-3. Haul Distance Calculations

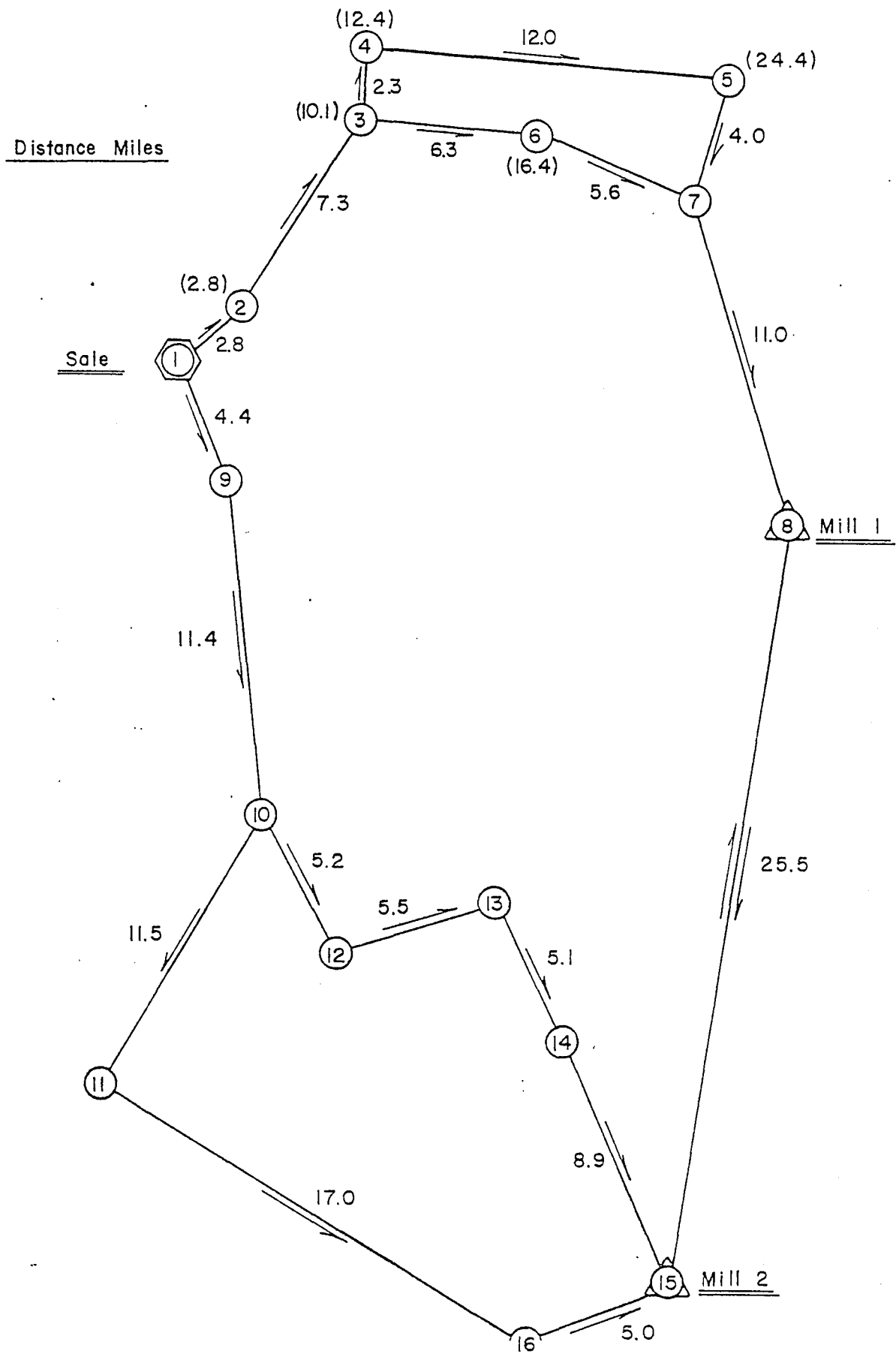
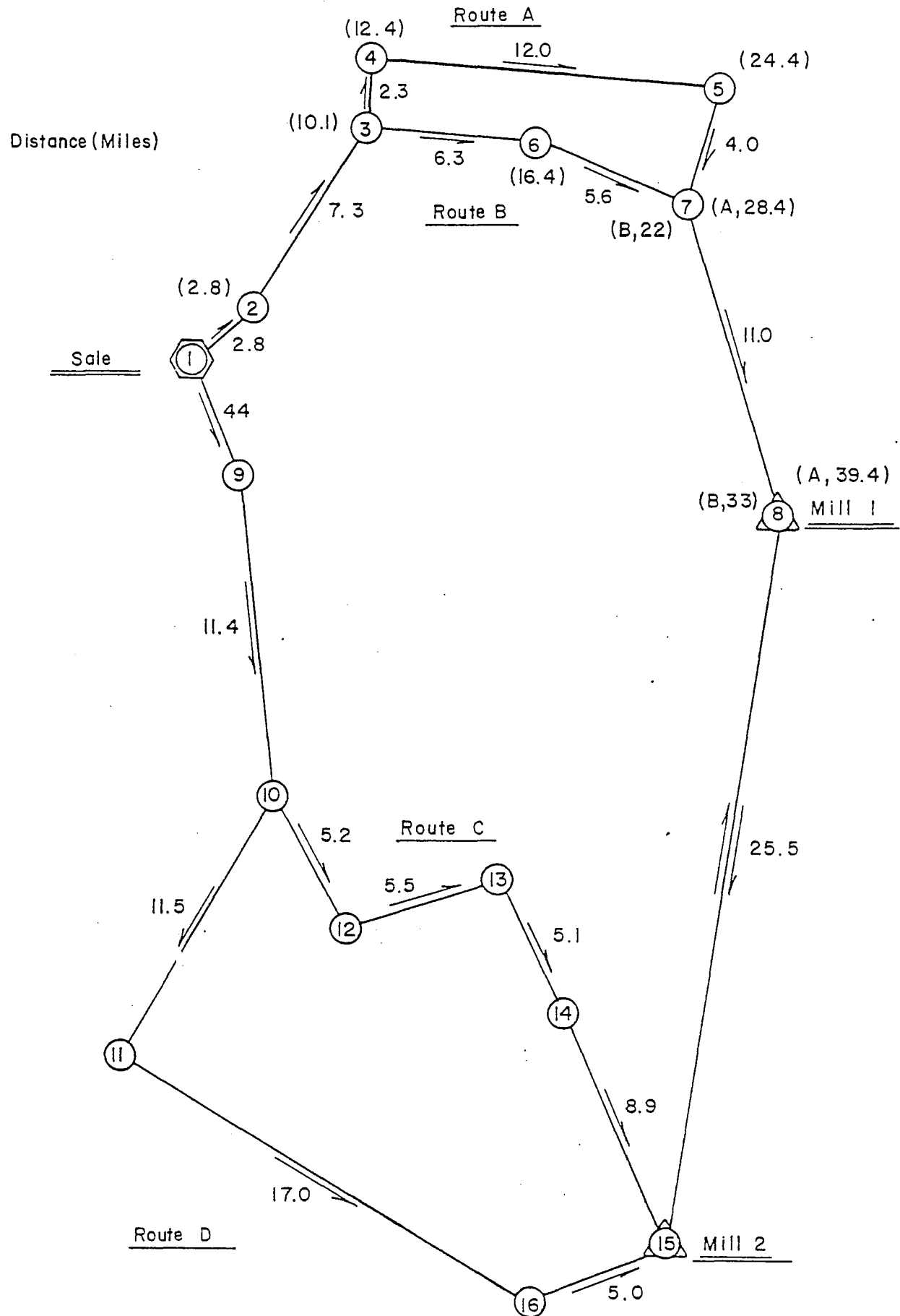


Figure D-4. Haul Distance Calculations



# Figure D-5. Haul Distance Calculations

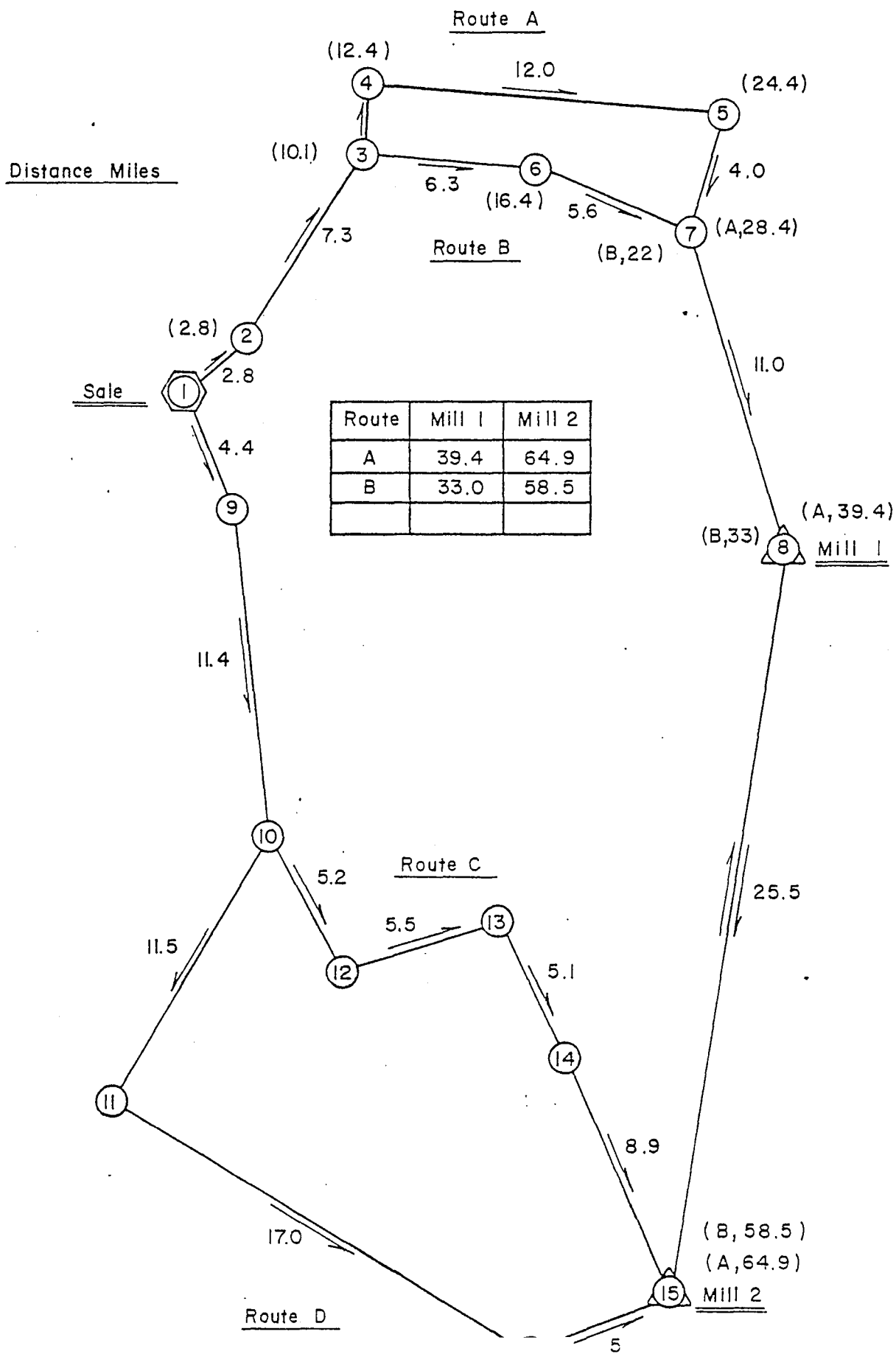
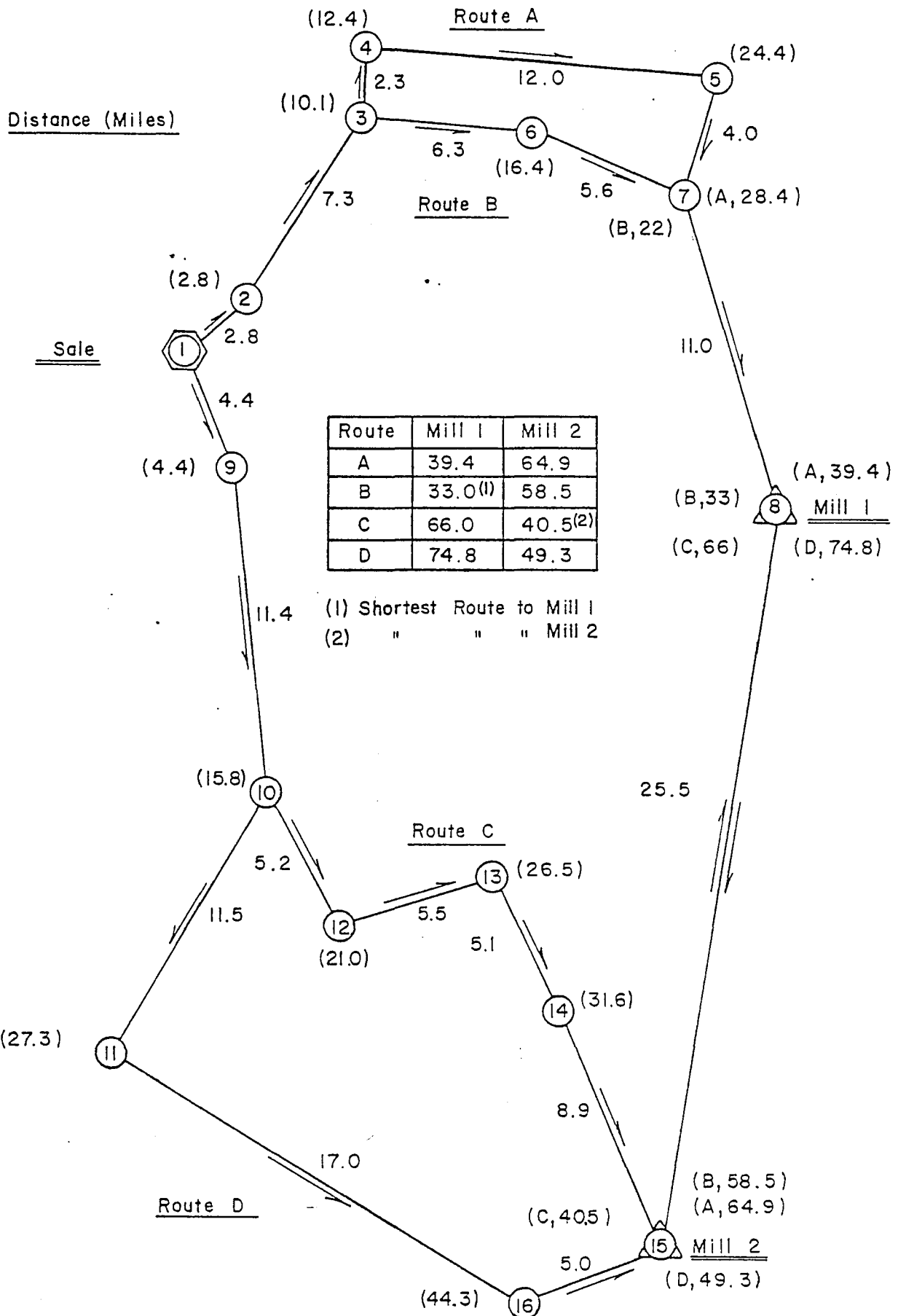


Figure D-6. Completed Haul Distances



Route C, 40.5 miles. This is the third shortest haul route and is slightly longer than the second shortest haul route. Route A to Mill 1, steps 2 through 6 must now be repeated for haul time and haul costs.

### E. Travel Time Computations

TABLE 2. (See Appendix) shows Round Trip Travel Time in minutes/mile for "On Highway" logging trucks, for each Haul Cost Class. These items are Derived from TABLE 2.a. ROUND TRIP TRAVEL SPEED.

This Table 2.a. was developed using Byrne, Nelson, and Googins', "Logging Road Handbook," December 1960, corrected for 1976 truck horsepower and the 55 mph speed limit.

#### 1. Round Trip Travel Time

Round Trip Travel Time is calculated in the same manner as Haul distance with one addition. The time for each link must be calculated prior to adding up the time for each possible haul route. For example - Link 1-2:

- (1) Haul Cost Class from the last column of Figure C-3.2. is 274.
- (2) Distance from Column 3 of Figure C-3.2. (or from Figure D-1.) is 2.8 miles.
- (3) Round Trip Travel Time for "On Highway" logging trucks from Table 2 (See Appendix) is 9.23 minutes/miles for haul cost class 274 as shown in Figure E-1.
- (4) Round Trip Travel Time for link 1-2 is  $9.23 \text{ minutes/mile} \times 2.8 \text{ miles} = 25.8 \text{ minutes}$ .

Computation of individual link travel times should be shown on the Network Schematic as shown in Figure E-2.

#### 2. Completed Calculation of Round Trip Travel Times

All routes to both mills are analyzed and travel times are reduced to hours and minutes for comparison. See Figure E-3. Completed Round Trip Travel Times. Note that Route A has the shortest round trip travel time to both mills. Route B the shortest distance to Mill 1. Route C is the shortest distance to Mill 2.

#### 3. Delay Time

In addition to Haul Time, time is lost in delay inherent to the logging operation which must be considered. Byrne, Nelson

Figure E-1 TABLE 2. (PAGE 2 OF 2)  
 ROUND TRIP TRAVEL TIME FOR LOG HIGHWAY  
 LOGGING TRUCKS BY HAUL CLASS IN MINUTES/MILE

| HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE |
|---------------|-------------|---------------|-------------|---------------|-------------|---------------|-------------|---------------|-------------|
| 161           | 3.53        | 193           | 3.43        | 225           | 4.00        | 257           | 5.00        | 289           | 6.00        |
| 162           | 3.53        | 194           | 3.43        | 226           | 4.00        | 258           | 5.00        | 290           | 6.00        |
| 163           | 4.14        | 195           | 4.04        | 227           | 4.45        | 259           | 5.23        | 291           | 6.33        |
| 164           | 5.08        | 196           | 5.14        | 228           | 6.06        | 260           | 6.79        | 292           | 8.00        |
| 165           | 5.03        | 197           | 5.14        | 229           | 5.38        | 261           | 6.14        | 293           | 7.47        |
| 166           | 7.16        | 198           | 8.00        | 230           | 8.61        | 262           | 10.20       | 294           | 14.29       |
| 167           | 6.25        | 199           | 6.25        | 231           | 6.61        | 263           | 8.61        | 295           | 10.67       |
| 168           | 9.75        | 200           | 9.33        | 232           | 10.20       | 264           | 12.57       | 296           | 20.00       |
| 169           | 3.75        | 201           | 4.00        | 233           | 4.62        | 265           | 5.45        | 297           | 10.00       |
| 170           | 3.75        | 202           | 4.00        | 234           | 4.62        | 266           | 5.45        | 298           | 10.00       |
| 171           | 4.02        | 203           | 4.31        | 235           | 4.81        | 267           | 5.73        | 299           | 10.91       |
| 172           | 5.64        | 204           | 5.56        | 236           | 6.40        | 268           | 7.47        | 300           | 10.91       |
| 173           | 5.64        | 205           | 5.38        | 237           | 5.64        | 269           | 7.01        | 301           | 13.33       |
| 174           | 8.61        | 206           | 7.47        | 238           | 9.33        | 270           | 12.57       | 302           | 21.67       |
| 175           | 6.61        | 207           | 6.06        | 239           | 7.01        | 271           | 9.75        | 303           | 18.67       |
| 176           | 10.67       | 208           | 9.75        | 240           | 11.25       | 272           | 16.62       | 304           | 28.57       |
| 177           | 4.29        | 209           | 4.80        | 241           | 5.23        | 273           | 9.23        | 305           | 13.33       |
| 178           | 4.29        | 210           | 4.80        | 242           | 5.23        | 274           | 9.23        | 306           | 13.33       |
| 179           | 4.64        | 211           | 5.01        | 243           | 5.47        | 275           | 10.00       | 307           | 17.50       |
| 180           | 7.29        | 212           | 6.61        | 244           | 7.01        | 276           | 10.00       | 308           | 16.07       |
| 181           | 7.29        | 213           | 6.15        | 245           | 6.61        | 277           | 12.00       | 309           | 27.50       |
| 182           | 11.25       | 214           | 10.20       | 246           | 11.25       | 278           | 18.00       | 310           | 22.50       |
| 183           | 8.33        | 215           | 8.33        | 247           | 8.98        | 279           | 16.00       | 311           | 40.00       |
| 184           | 15.00       | 216           | 12.57       | 248           | 14.29       | 280           | 22.50       | 312           | 40.00       |
| 185           | 5.50        | 217           | 8.00        | 249           | 8.57        | 281           | 12.00       | 313           | 15.00       |
| 186           | 5.50        | 218           | 8.00        | 250           | 8.57        | 282           | 12.00       | 314           | 15.00       |
| 187           | 5.77        | 219           | 8.57        | 251           | 9.23        | 283           | 13.33       | 315           | 20.57       |
| 188           | 7.77        | 220           | 8.57        | 252           | 9.23        | 284           | 15.24       | 316           | 18.57       |
| 189           | 7.77        | 221           | 9.62        | 253           | 10.91       | 285           | 14.17       | 317           | 38.57       |
| 190           | 12.57       | 222           | 13.19       | 254           | 15.00       | 286           | 21.67       | 318           | 28.57       |
| 191           | 14.29       | 223           | 15.00       | 255           | 15.24       | 287           | 18.67       | 319           | 42.00       |
| 192           | 15.00       | 224           | 16.00       | 256           | 18.67       | 288           | 28.57       | 320           | 42.00       |

Figure E-2. Round Trip Travel Time

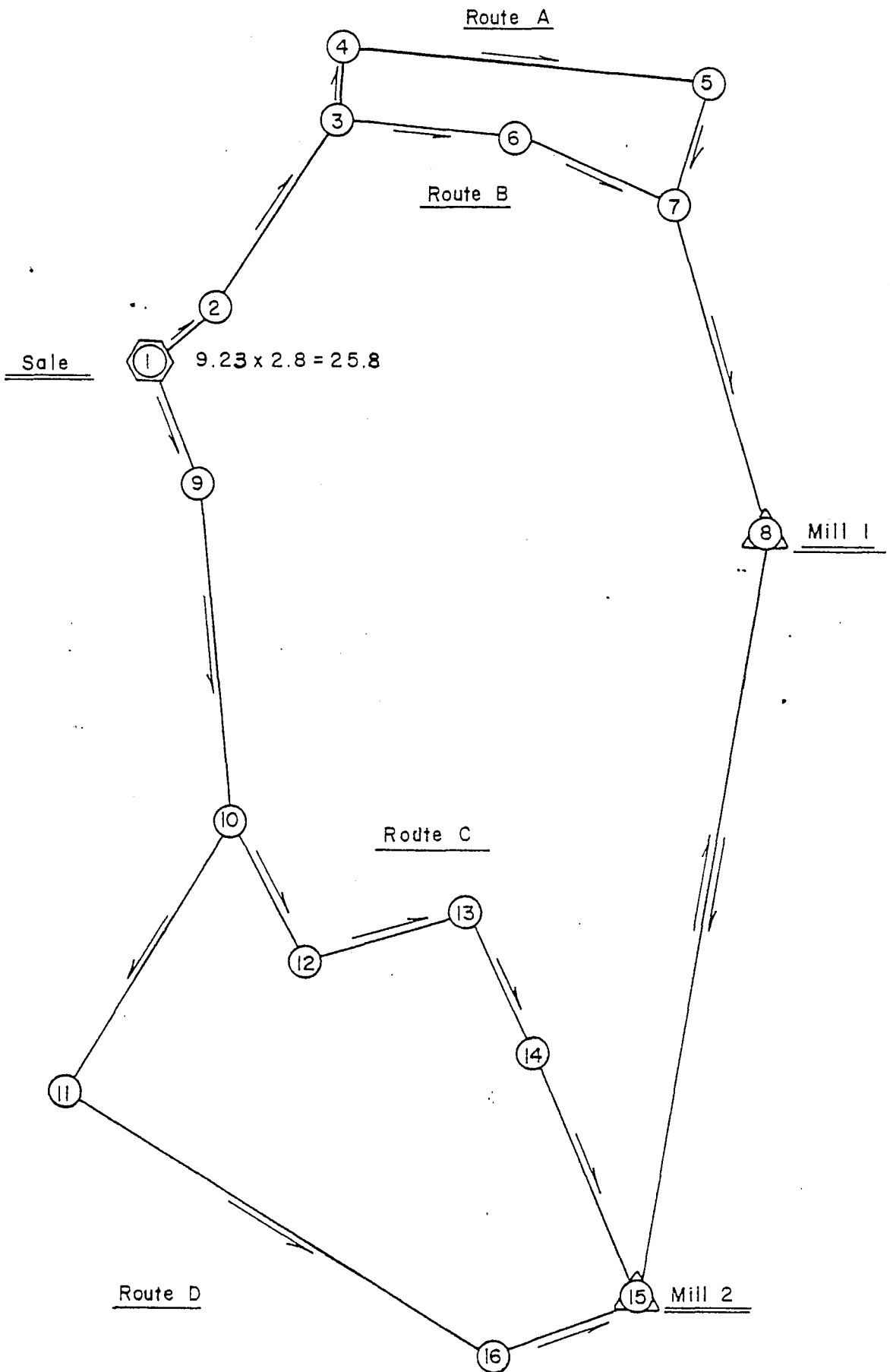
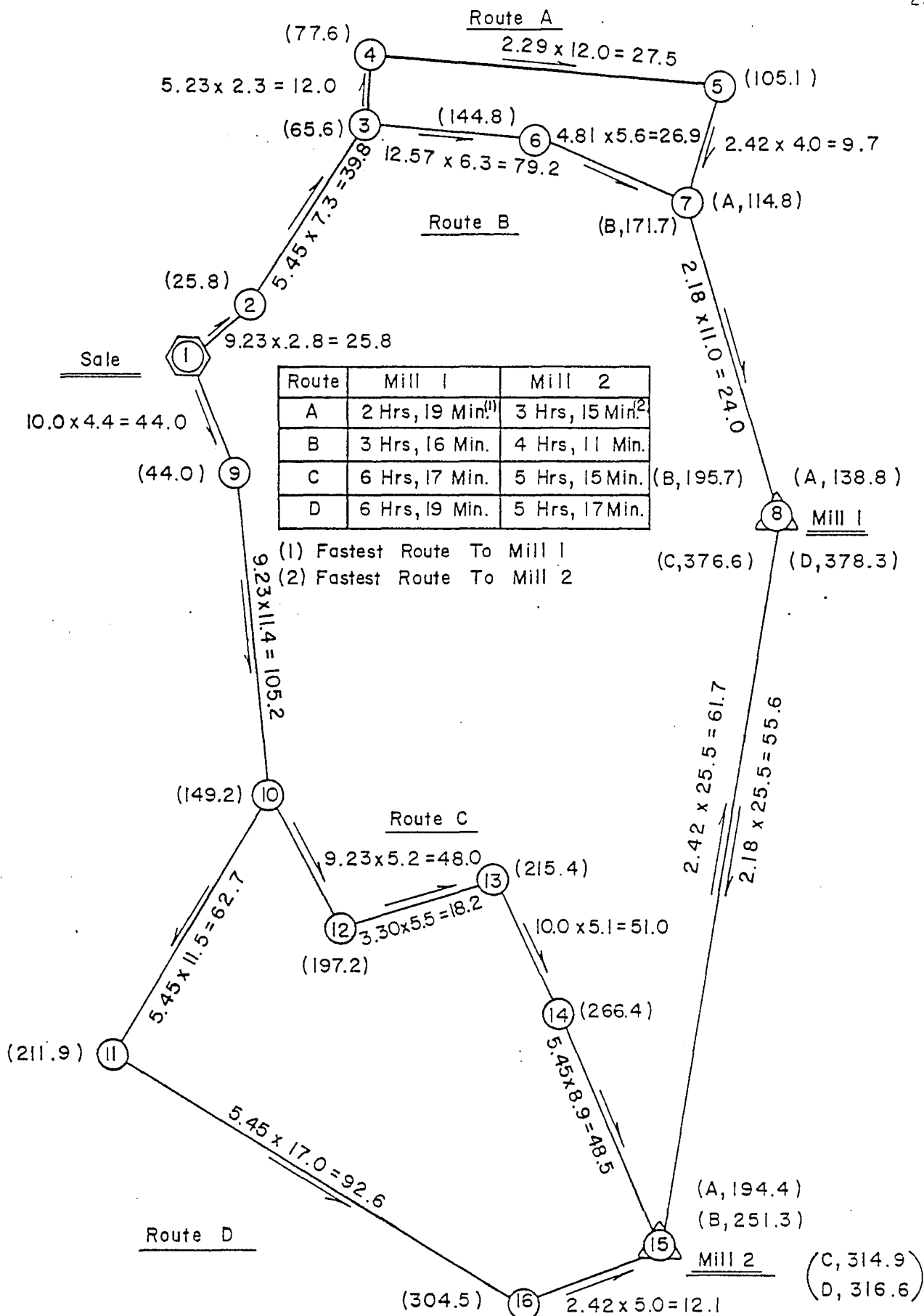


Figure E-3. Completed Round Trip Travel Times



and Googins collected much data on delay time and arrived at their Table 24, included here as Figure E-4. The delay times involved were waiting for loader, loading, scaling, waiting for unloader, unloading, and miscellaneous.

Example: For a 5 MBF load, Delay Time would be between 11.92 and 15.34 minutes per MBF or 13.63 minutes.

#### 4. Total Round Trip Time

The total round trip time is the sum of the round trip travel times plus the delay time. For example, total round trip travel time on Route A for a 5 MBF load from the sale to the Mill 1 is 2 hours 19 minutes (from Figure E-3.) plus  $13.63 \times 5 = 68$  minutes (from Figure E-4.) for a total of 3 hours and 27 minutes.

### F. Haul Cost Computations

#### 1. Haul Cost Relationship

Haul cost is calculated like haul time with one addition. At 1 mile and 30 miles from the sale, unit haul costs change. This change is caused by the fact that per mile haul costs are not constant for a given haul class but change as the length of the haul increases. Long hauls are more efficient on a cost per mile basis than short hauls since fixed costs are spread over a longer distance. Figure F-1. Haul Cost Relationship shows a typical haul cost curve with the actual cost plotted against distance in a solid line. This curve is approximated by three straight dashed lines of slopes  $a_1$ ,  $a_2$  and  $a_3$  which are used for analysis purposes.

#### 2. Link Haul Costs

Table 3 (See Appendix) shows three haul cost per mile figures for each haul cost class. These three figures are the slopes of the three dashed lines shown in Figure F-1. For example, Figure F-2. Use Of Table 3, a page from Table 3, shows unit costs for links 9-10 and 10-12 (Haul Cost Class 274, See Figure C-3.2 or C.4)., where unit costs change from \$3.00/MBF/mile to \$0.7692/MBF/mile at 1.0 mile and to \$0.4615/MBF/mile at 30.0 miles. These costs are based on the rental rate for long term rental (ownership) rate plus operations and operator costs for the middle cost figure for 1-30 mile range. The first cost figure for the first mile is normally 4 times the 1-30 mile column and column 30+miles is 0.6 times the 1 to 30 mile cost.

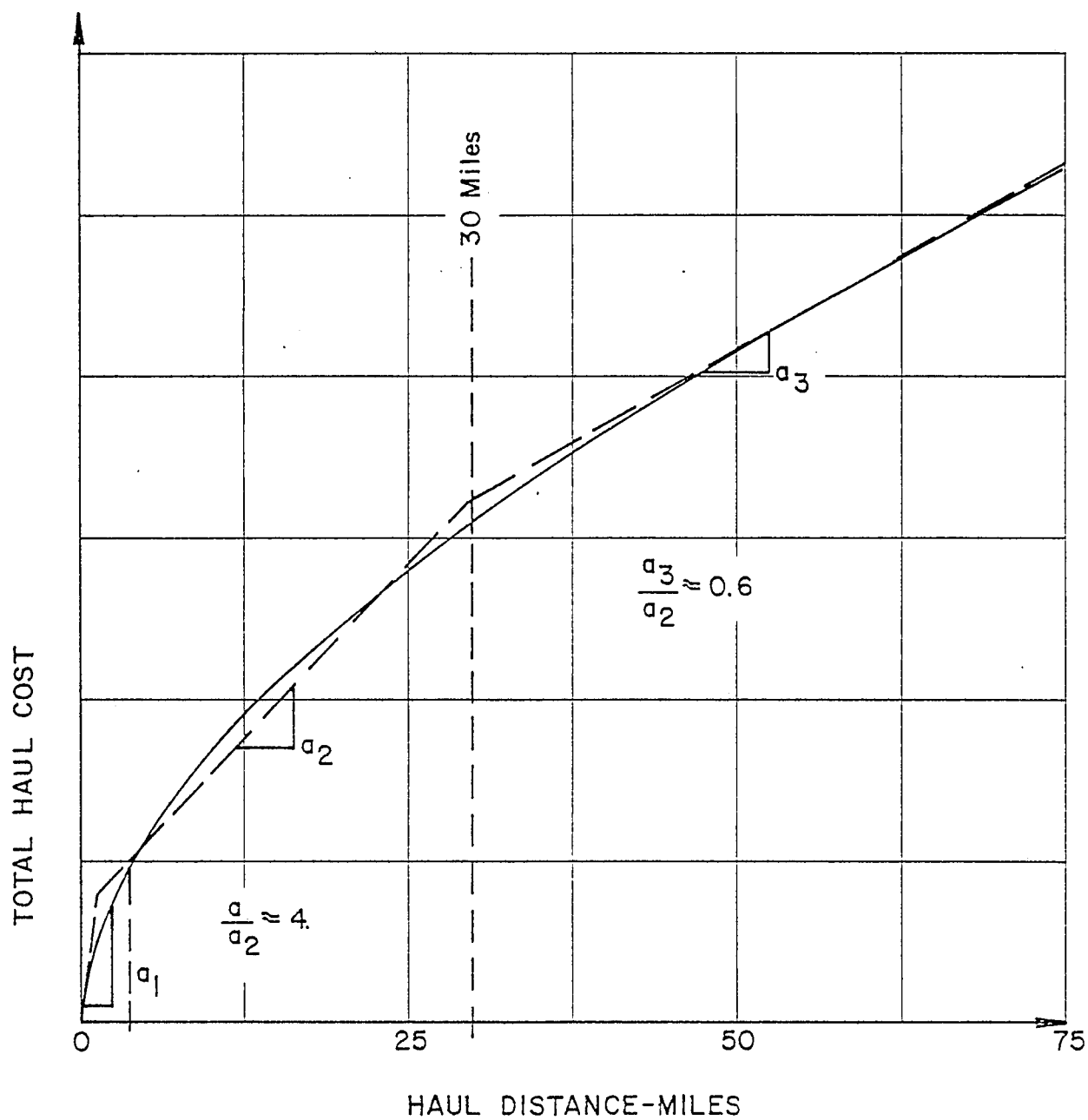
FIGURE E-4. AVERAGE DELAY OTHER THAN ROAD DESIGN

TABLE 24.--Average delay time per M board feet, by kind of delay

| Kind of delay            | Delay time when board-foot load is-- |         |         |         |         |         |         |         |         |
|--------------------------|--------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|
|                          | 4 M                                  | 6 M     | 8 M     | 10 M    | 12 M    | 14 M    | 16 M    | 18 M    | 20 M    |
|                          | Minutes                              | Minutes | Minutes | Minutes | Minutes | Minutes | Minutes | Minutes | Minutes |
| Waiting for loader-----  | 4.40                                 | 2.83    | 2.20    | 1.76    | 1.47    | 1.26    | 1.10    | 0.98    | 0.88    |
| Loading-----             | 3.77                                 | 3.77    | 3.77    | 3.77    | 3.77    | 3.77    | 3.77    | 3.77    | 3.77    |
| Scaling-----             | .85                                  | .85     | .85     | .85     | .85     | .85     | .85     | .85     | .85     |
| Waiting for unloader---- | 1.42                                 | .94     | .71     | .57     | .47     | .40     | .35     | .31     | .28     |
| Unloading-----           | 2.18                                 | 1.72    | 1.48    | 1.36    | 1.27    | 1.20    | 1.15    | 1.11    | 1.08    |
| Miscellaneous-----       | 2.72                                 | 1.81    | 1.36    | 1.09    | .90     | .78     | .68     | .60     | .54     |
| Total-----               | 15.34                                | 11.92   | 10.37   | 9.40    | 8.73    | 8.26    | 7.90    | 7.62    | 7.40    |

FIGURE F-1. HAUL COST RELATIONSHIP

HAUL COST VERSUS HAUL DISTANCE



### 3. Total Haul Cost

Since unit haul cost values change at 1 and 30.0 miles from the start of the haul, it is necessary to make two cost calculations for the links where these changes take place. In this example, changes at 1 mile occur on links 1-2 and 1-9 and changes at 30 miles occur on links 7-8, 11-16, and 13-14.

The round trip haul cost for link 1-9, from Figure F-2 is \$3.00 for the first mile and \$0.8333/MBF/mile for the next 3.4 miles or \$2.83, for mile 1.0 to mile 4.4, for a total of \$5.83/MBF for the link.

For link 13-14, the round trip haul cost is \$0.833/MBF/mile for the first 3.5 miles plus \$0.50/MBF/mile for 1.6 miles, or \$2.92/MBF for mile 26.5 to mile 30.0 plus \$.80 for mile 30.0 to mile 31.6, making a total of \$3.72 for the link.

### 4. Total Route Haul Costs

Links 1-2, 7-8, and 11-16 are treated in a similar fashion. The rest of the links require only one cost calculation as does travel time and distance. See Figure F-3. Completed Haul Costs for the summed total haul costs. Note, that Route A has the lowest haul cost from the sale to both mills.

### 5. Delay Costs

Delay costs should be apportioned at the operator plus rental rate cost per hour (excluding operating expenses). Thus a \$16.00 per hour rate is right. For the 5 MBF load the delay cost per MBF would be the 13.63 minutes times \$16.00 per hour corrected for a 60 minute hour or:

$$\frac{13.63 \text{ minutes}}{\text{MBF}} \times \frac{\$16.00}{\text{hour}} \times \frac{\text{hour}}{60 \text{ minutes}} = \$3.63/\text{MBF}$$

### 6. Total Round Trip Costs

The \$3.63/MBF delay cost would be a fixed cost added to all Haul routes. Therefore, the minimum cost from the sale to mill 1 would be via Route A at \$13.12/MBF haul costs plus \$3.63/MBF delay costs for a total round trip cost of \$16.75 per MBF.

## III. Cost Optimization

### G-1. Road Maintenance and Reconstruction Costs

The most economically efficient haul route is the route that has the lowest total of haul, construction and maintenance costs. This will be the "optimal" route from a cost standpoint.

Figure F-2. TABLE 3. (PAGE 5 OF 5)  
 ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| UNIT COST(\$/MBF/MILE) |        |        |        | UNIT COST(\$/MBF/MILE) |        |        |        |
|------------------------|--------|--------|--------|------------------------|--------|--------|--------|
| HAUL                   | 0-1    | 1.1-30 | 30.1+  | HAUL                   | 0-1    | 1.1-30 | 30.1+  |
| CLASS                  | MILES  | MILES  | MILES  | CLASS                  | MILES  | MILES  | MILES  |
| 257                    | 1.6667 | .4167  | .2500  | 289                    | 2.0000 | .5000  | .3000  |
| 258                    | 1.6667 | .4167  | .2500  | 290                    | 2.0000 | .5000  | .3000  |
| 259                    | 1.7424 | .4356  | .2614  | 291                    | 2.1111 | .5278  | .3167  |
| 260                    | 2.2619 | .5655  | .3393  | 292                    | 2.6667 | .6667  | .4000  |
| 261                    | 2.0460 | .5115  | .3069  | 293                    | 2.4908 | .6227  | .3736  |
| 262                    | 3.0000 | .8497  | .5098  | 294                    | 3.0000 | 1.1905 | .7143  |
| 263                    | 2.8708 | .7177  | .4306  | 295                    | 3.0000 | .8889  | .5333  |
| 264                    | 3.0000 | 1.0476 | .6286  | 296                    | 3.3333 | 1.6667 | 1.0000 |
| 265                    | 1.8182 | .4545  | .2727  | 297                    | 3.0000 | .8333  | .5000  |
| 266                    | 1.8182 | .4545  | .2727  | 298                    | 3.0000 | .8333  | .5000  |
| 267                    | 1.9091 | .4773  | .2864  | 299                    | 3.0000 | .9091  | .5455  |
| 268                    | 2.4908 | .6227  | .3736  | 300                    | 3.0000 | .9091  | .5455  |
| 269                    | 2.3377 | .5844  | .3506  | 301                    | 3.0000 | 1.1111 | .6667  |
| 270                    | 3.0000 | 1.0476 | .6286  | 302                    | 3.6111 | 1.8056 | 1.0833 |
| 271                    | 3.0000 | .8125  | .4875  | 303                    | 3.1111 | 1.5556 | .9333  |
| 272                    | 3.0000 | .7333  | .4333  | 304                    | 4.7619 | 2.3810 | 1.4286 |
| 273                    | 3.0000 | .7333  | .4333  | 305                    | 3.0000 | 1.1111 | .6667  |
| 274                    | 3.0000 | .7692  | .4615  | 306                    | 3.0000 | 1.1111 | .6667  |
| 275                    | 3.0000 | .8333  | .5000  | 307                    | 3.0000 | 1.4583 | .8750  |
| 276                    | 3.0000 | .8333  | .5000  | 308                    | 3.0000 | 1.3393 | .8036  |
| 277                    | 3.0000 | 1.0000 | .6000  | 309                    | 4.5833 | 2.2917 | 1.3750 |
| 278                    | 3.0000 | 1.5000 | .9000  | 310                    | 3.7500 | 1.8750 | 1.1250 |
| 279                    | 3.0000 | 1.3333 | .8000  | 311                    | 6.6667 | 3.3333 | 2.0000 |
| 280                    | 3.7500 | 1.8750 | 1.1250 | 312                    | 6.6667 | 3.3333 | 2.0000 |
| 281                    | 3.0000 | 1.0000 | .6000  | 313                    | 3.0000 | 1.2500 | .7500  |
| 282                    | 3.0000 | 1.0000 | .6000  | 314                    | 3.0000 | 1.2500 | .7500  |
| 283                    | 3.0000 | 1.1111 | .6667  | 315                    | 3.4286 | 1.7143 | 1.0286 |
| 284                    | 3.0000 | 1.2698 | .7619  | 316                    | 3.0952 | 1.5476 | .9286  |
| 285                    | 3.0000 | 1.1806 | .7083  | 317                    | 6.4286 | 3.2143 | 1.9286 |
| 286                    | 3.6111 | 1.8056 | 1.0833 | 318                    | 4.7619 | 2.3810 | 1.4286 |
| 287                    | 3.1111 | 1.5556 | .9333  | 319                    | 7.0000 | 3.5000 | 2.1000 |
| 288                    | 4.7619 | 2.3810 | 1.4286 | 320                    | 7.0000 | 3.5000 | 2.1000 |

Figure F-3. Completed Haul Costs

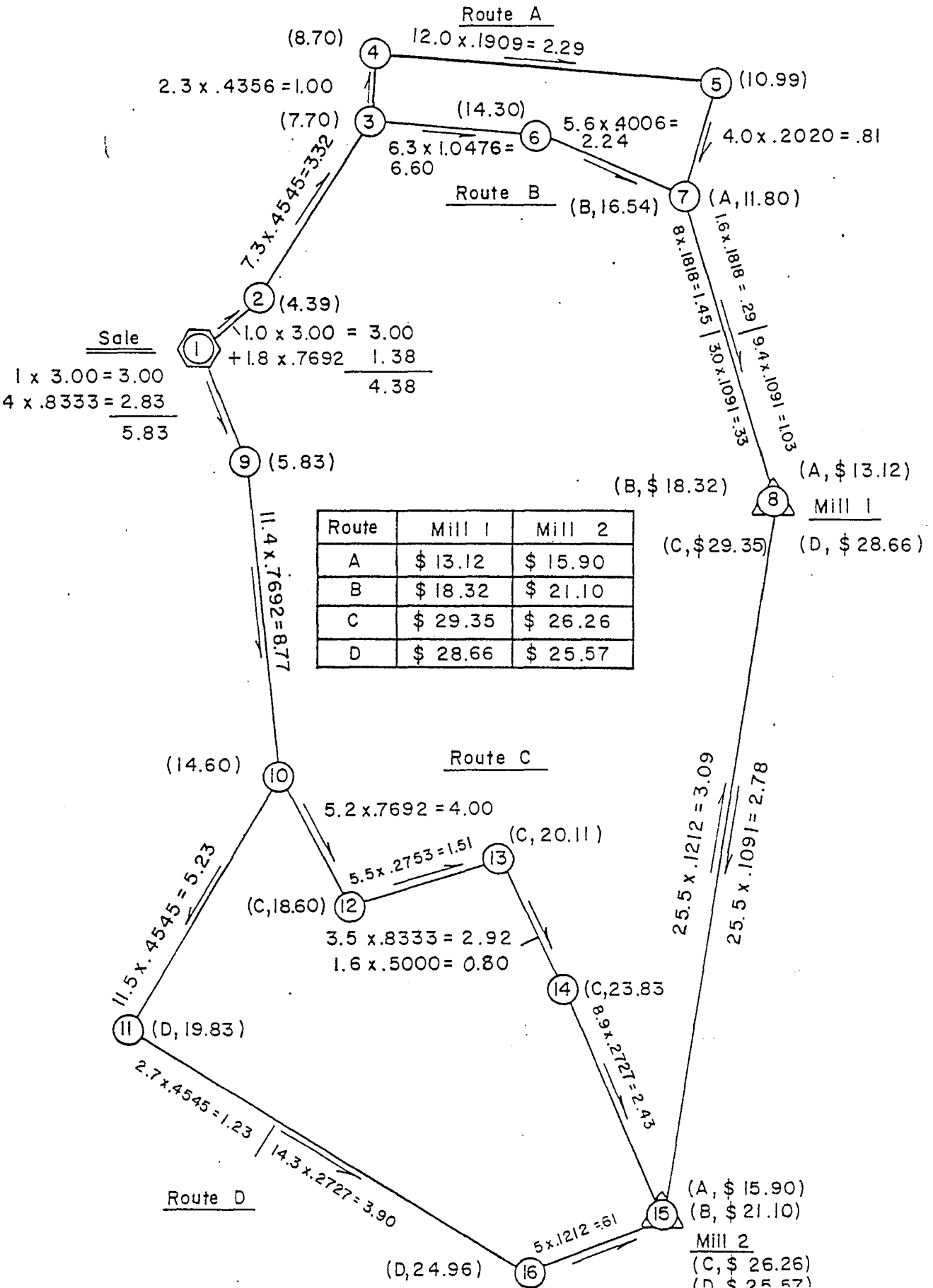


Figure G-1. Road Maintenance and Reconstruction Costs shows the size of the Sale, and portions of the network which would require reconstruction and maintenance. Reconstruction would be required to bring links 1-2 and 1-9 up to minimum standards for a haul route as noted in section C-3.

In this example, a sale duration of two years has been selected for a volume of 3.5 MMBF.

Road Maintenance is dependent upon many factors such as road surface, location, haul use, etc., and must be determined by the Forest Engineering Staff. Use TABLES 4, 4a, 5, and 6 in the Appendix for determining ROAD MAINTENANCE COSTS.

## G2. Total Transportation Cost Optimization

Figure G-2. Total Haul Cost Optimization shows Route A to Mill 1 to have a total cost of \$83,325 the lowest overall cost of the four possible routes to the two available mills. If the timber was to be hauled to Mill 2, Route A would still be the least expensive route at a total cost of \$93,055. Route A is approximately 30% cheaper than Route B. Route A is the fastest route, but not the shortest, Route B is the shortest. (Refer to FSM 2420.33 for the criteria to use in choosing the appraisal points.)

For this example, taking distance, time, and cost into consideration the sale should be appraised to Mill 1 over Route A at a cost of \$16.75/MBF. This will involve the reconstruction of the first 2.8 miles of haul route to a single lane graded and drained road with poor alignment (Design Criteria Class D) at a cost of \$15,400. It will also involve the maintenance of 12.4 miles of road at a cost of \$375/mile/year for the two years of the sale, or \$750/mile. This appraisal method of analyzing maintenance costs is slightly different from overall transportation planning. The total maintenance cost including maintenance costs on State roads should be considered to evaluate the most economical transportation system if the purchaser will be expected to perform maintenance on State or county roads due to maintenance agreements with these agencies. Otherwise, for appraisal purposes, the state, county, and other local government road maintenance costs should not be included, as gas taxes and the 25 percent fund cover these local government expenses. See Appendix - Table 4. ROAD MAINTENANCE COSTS for maintenance cost data.

Since the sale node location is important to the least cost alternative, sale road planning could also benefit from the network analysis; e.g., could the sale node (landing) be relocated to avoid high reconstruction costs on the main haul network. In other words, the entire sale road network should be analyzed to make maximum use of the information developed on haul routes during the foregoing network analysis procedure. This would insure that landings, spur roads and sale roads are located in the most economical positions.

Figure G-1. Road Maintenance and Reconstruction Costs

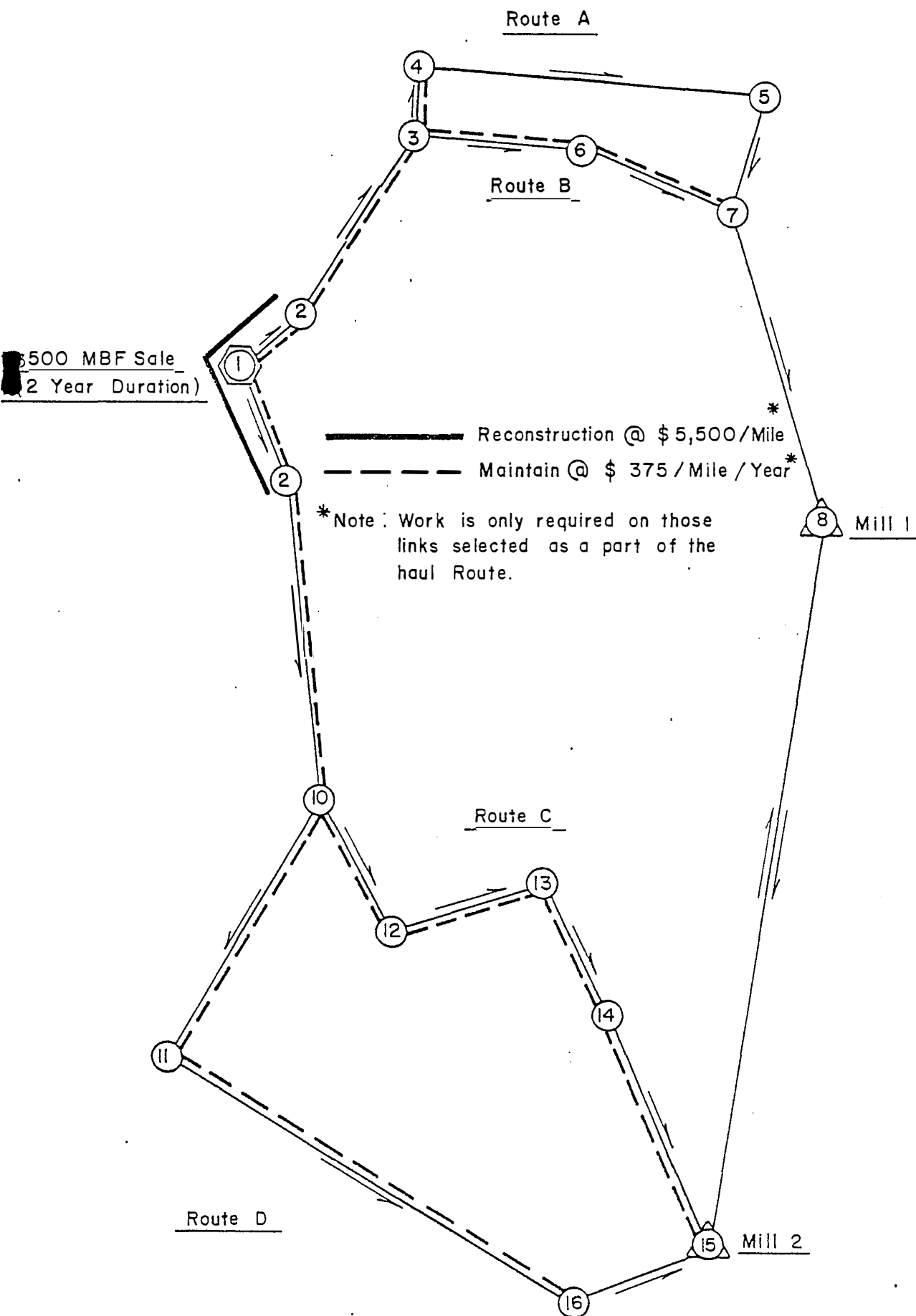


Figure G-2. Total Haul Cost Optimization

| Mill | Route | Haul Cost |         | Maintenance |         | Construction |         | Total   |
|------|-------|-----------|---------|-------------|---------|--------------|---------|---------|
|      |       | \$ /MBF   | Dollars | Miles       | Dollars | Miles        | Dollars | Dollars |
| 1    | A     | 16.75     | 58,625  | 12.4        | 9300    | 2.8          | 15,400  | 83,325  |
|      | B     | 21.95     | 76,825  | 22.0        | 16,500  | 2.8          | 15,400  | 108,725 |
|      | C     | 32.98     | 115,430 | 40.5        | 30,400  | 4.4          | 24,200  | 170,030 |
|      | D     | 32.29     | 113,015 | 44.3        | 33,200  | 4.4          | 24,200  | 170,415 |
| 2    | A     | 19.53     | 68,355  | 12.4        | 9,300   | 2.8          | 15,400  | 93,055  |
|      | B     | 24.73     | 86,555  | 22.0        | 16,500  | 2.8          | 15,400  | 118,455 |
|      | C     | 29.89     | 104,615 | 40.5        | 30,400  | 4.4          | 24,200  | 159,215 |
|      | D     | 29.20     | 102,200 | 44.3        | 33,200  | 4.4          | 24,200  | 159,600 |

TABLE 1.- HAUL CLASSES

## HAUL CLASSES

| No.<br>Lanes | Road<br>Surface                 | Horizontal<br>Alignment | Average Grade in Direction of Haul |      |     |     |                       |     |      |     |
|--------------|---------------------------------|-------------------------|------------------------------------|------|-----|-----|-----------------------|-----|------|-----|
|              |                                 |                         | % Adverse Grade (+)                |      |     |     | % Favorable Grade (-) |     |      |     |
|              |                                 |                         | >10                                | 10-7 | 7-4 | 4-0 | 0-4                   | 4-7 | 7-10 | >10 |
| 2            | -A-<br>Paved                    | A-Excellent             | 8                                  | 6    | 4   | 2   | 7                     | 3   | 5    | 7   |
|              |                                 | B-Good                  | 16                                 | 14   | 12  | 10  | 9                     | 11  | 13   | 15  |
|              |                                 | C-Fair                  | 24                                 | 22   | 20  | 18  | 17                    | 19  | 21   | 23  |
|              |                                 | D-Poor                  | 32                                 | 30   | 28  | 26  | 25                    | 27  | 29   | 31  |
|              | -B-<br>Gravel                   | A-Excellent             | 40                                 | 38   | 36  | 34  | 33                    | 35  | 37   | 39  |
|              |                                 | B-Good                  | 48                                 | 46   | 44  | 42  | 41                    | 43  | 45   | 47  |
|              |                                 | C-Fair                  | 56                                 | 54   | 52  | 50  | 49                    | 51  | 53   | 55  |
|              |                                 | D-Poor                  | 64                                 | 62   | 60  | 58  | 57                    | 59  | 61   | 63  |
|              | -C-<br>Graded<br>and<br>Drained | E-Excellent             | 72                                 | 70   | 68  | 66  | 65                    | 67  | 69   | 71  |
|              |                                 | B-Good                  | 80                                 | 78   | 76  | 74  | 73                    | 75  | 77   | 79  |
|              |                                 | C-Fair                  | 88                                 | 86   | 84  | 82  | 81                    | 83  | 85   | 87  |
|              |                                 | D-Poor                  | 96                                 | 94   | 92  | 90  | 89                    | 91  | 93   | 95  |
| 1 1/2        | -A-<br>Paved                    | A-Excellent             | 104                                | 102  | 100 | 98  | 97                    | 99  | 101  | 103 |
|              |                                 | B-Good                  | 112                                | 110  | 108 | 106 | 105                   | 107 | 109  | 111 |
|              |                                 | C-Fair                  | 120                                | 118  | 116 | 114 | 113                   | 115 | 117  | 119 |
|              |                                 | D-Poor                  | 128                                | 126  | 124 | 122 | 121                   | 123 | 125  | 127 |
|              | -B-<br>Gravel                   | A-Excellent             | 136                                | 134  | 132 | 130 | 129                   | 131 | 133  | 135 |
|              |                                 | B-Good                  | 144                                | 142  | 140 | 138 | 137                   | 139 | 141  | 143 |
|              |                                 | C-Fair                  | 152                                | 150  | 148 | 146 | 145                   | 147 | 149  | 151 |
|              |                                 | D-Poor                  | 160                                | 158  | 156 | 154 | 153                   | 155 | 157  | 159 |
|              | -C-<br>Graded<br>and<br>Drained | A-Excellent             | 168                                | 166  | 164 | 162 | 161                   | 163 | 165  | 167 |
|              |                                 | B-Good                  | 176                                | 174  | 172 | 170 | 169                   | 171 | 173  | 175 |
|              |                                 | C-Fair                  | 184                                | 182  | 180 | 178 | 177                   | 179 | 181  | 183 |
|              |                                 | D-Poor                  | 192                                | 190  | 188 | 186 | 185                   | 187 | 189  | 191 |
| 1            | -A-<br>Paved                    | A-Excellent             | 200                                | 198  | 196 | 194 | 193                   | 195 | 197  | 199 |
|              |                                 | B-Good                  | 208                                | 206  | 204 | 202 | 201                   | 203 | 205  | 207 |
|              |                                 | C-Fair                  | 216                                | 214  | 212 | 210 | 209                   | 211 | 213  | 215 |
|              |                                 | D-Poor                  | 224                                | 222  | 220 | 218 | 217                   | 219 | 221  | 223 |
|              | -B-<br>Gravel                   | A-Excellent             | 232                                | 230  | 228 | 226 | 225                   | 227 | 229  | 231 |
|              |                                 | B-Good                  | 240                                | 238  | 236 | 234 | 233                   | 235 | 237  | 239 |
|              |                                 | C-Fair                  | 248                                | 246  | 244 | 242 | 241                   | 243 | 245  | 247 |
|              |                                 | D-Poor                  | 256                                | 254  | 252 | 250 | 249                   | 251 | 253  | 255 |
|              | -C-<br>Graded<br>and<br>Drained | B-Good                  | 264                                | 262  | 260 | 258 | 257                   | 259 | 261  | 263 |
|              |                                 | C-Fair                  | 272                                | 270  | 268 | 266 | 265                   | 267 | 269  | 271 |
|              |                                 | D-Poor                  | 280                                | 278  | 276 | 274 | 273                   | 275 | 277  | 279 |
|              |                                 | E-Primitive             | 288                                | 286  | 284 | 282 | 281                   | 283 | 285  | 287 |
|              | -D-<br>Primitive                | B-Good                  | 296                                | 294  | 292 | 290 | 289                   | 291 | 293  | 295 |
|              |                                 | C-Fair                  | 304                                | 302  | 300 | 298 | 297                   | 299 | 301  | 303 |
|              |                                 | D-Poor                  | 312                                | 310  | 308 | 306 | 305                   | 307 | 309  | 311 |
|              |                                 | E-Primitive             | 320                                | 318  | 316 | 314 | 313                   | 315 | 317  | 319 |

|           |                   |
|-----------|-------------------|
| Alignment | K                 |
| Excellent | $K > 100$         |
| Good      | $50 < K \leq 100$ |
| Fair      | $20 < K \leq 50$  |
| Poor      | $10 < K \leq 20$  |
| Primitive | $K \leq 10$       |

$$K = \frac{\bar{R}}{N}$$

$\bar{R}$ : Average radius of curvature between nodes

N: Number of curves / mile between nodes

NOTE: Logging truck can not negotiate primitive alignment

TABLE 2. (PAGE 1 OF 2)  
 ROUND TRIP TRAVEL TIME FOR 'ON HIGHWAY'  
 LOGGING TRUCKS BY HAUL CLASS IN MINUTES/MILE

| HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE |
|---------------|-------------|---------------|-------------|---------------|-------------|---------------|-------------|---------------|-------------|
| 1             | 2.18        | 33            | 2.53        | 65            | 2.73        | 97            | 2.73        | 129           | 3.43        |
| 2             | 2.42        | 34            | 2.75        | 66            | 2.95        | 98            | 3.00        | 130           | 3.43        |
| 3             | 2.81        | 35            | 3.13        | 67            | 3.50        | 99            | 3.16        | 131           | 3.76        |
| 4             | 4.11        | 36            | 4.50        | 68            | 4.87        | 100           | 4.34        | 132           | 4.64        |
| 5             | 3.90        | 37            | 4.22        | 69            | 4.50        | 101           | 4.22        | 133           | 4.64        |
| 6             | 5.64        | 38            | 6.14        | 70            | 6.48        | 102           | 6.14        | 134           | 6.75        |
| 7             | 5.00        | 39            | 5.14        | 71            | 5.64        | 103           | 5.14        | 135           | 5.93        |
| 8             | 7.00        | 40            | 8.33        | 72            | 8.98        | 104           | 7.77        | 136           | 8.98        |
| 9             | 2.29        | 41            | 2.77        | 73            | 2.86        | 105           | 2.93        | 137           | 3.43        |
| 10            | 2.70        | 42            | 2.94        | 74            | 3.10        | 106           | 3.08        | 138           | 3.43        |
| 11            | 2.91        | 43            | 3.30        | 75            | 3.61        | 107           | 3.37        | 139           | 3.89        |
| 12            | 4.73        | 44            | 5.14        | 76            | 5.38        | 108           | 5.14        | 140           | 5.38        |
| 13            | 4.44        | 45            | 5.00        | 77            | 5.23        | 109           | 4.87        | 141           | 5.23        |
| 14            | 6.40        | 46            | 7.47        | 78            | 8.00        | 110           | 7.01        | 142           | 8.00        |
| 15            | 5.33        | 47            | 5.93        | 79            | 6.25        | 111           | 5.75        | 143           | 6.25        |
| 16            | 7.77        | 48            | 9.75        | 80            | 10.67       | 112           | 8.98        | 144           | 9.75        |
| 17            | 2.53        | 49            | 3.18        | 81            | 3.26        | 113           | 3.34        | 145           | 3.87        |
| 18            | 3.05        | 50            | 3.32        | 82            | 3.45        | 114           | 3.45        | 146           | 3.87        |
| 19            | 3.43        | 51            | 3.72        | 83            | 3.84        | 115           | 3.84        | 147           | 4.34        |
| 20            | 5.14        | 52            | 5.93        | 84            | 6.25        | 116           | 6.25        | 148           | 6.86        |
| 21            | 4.87        | 53            | 5.48        | 85            | 5.75        | 117           | 5.75        | 149           | 6.86        |
| 22            | 7.22        | 54            | 8.61        | 86            | 9.33        | 118           | 9.33        | 150           | 10.20       |
| 23            | 6.06        | 55            | 6.61        | 87            | 7.01        | 119           | 7.01        | 151           | 7.77        |
| 24            | 8.98        | 56            | 10.67       | 88            | 11.79       | 120           | 11.79       | 152           | 13.19       |
| 25            | 3.21        | 57            | 3.54        | 89            | 3.65        | 121           | 4.34        | 153           | 5.26        |
| 26            | 3.40        | 58            | 4.02        | 90            | 4.16        | 122           | 4.34        | 154           | 5.26        |
| 27            | 3.72        | 59            | 4.47        | 91            | 4.64        | 123           | 4.64        | 155           | 5.50        |
| 28            | 5.64        | 60            | 6.25        | 92            | 6.61        | 124           | 6.61        | 156           | 7.29        |
| 29            | 5.48        | 61            | 6.61        | 93            | 7.01        | 125           | 7.01        | 157           | 7.29        |
| 30            | 8.31        | 62            | 9.33        | 94            | 10.20       | 126           | 9.53        | 158           | 11.25       |
| 31            | 6.79        | 63            | 7.47        | 95            | 8.33        | 127           | 8.00        | 159           | 12.57       |
| 32            | 9.75        | 64            | 11.79       | 96            | 13.19       | 128           | 11.28       | 160           | 13.19       |

TABLE 2. (PAGE 2 OF 2)  
 ROUND TRIP TRAVEL TIME FOR 'ON HIGHWAY'  
 LOGGING TRUCKS BY HAUL CLASS IN MINUTES/MILE

| HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE | HAUL<br>CLASS | MIN<br>MILE |
|---------------|-------------|---------------|-------------|---------------|-------------|---------------|-------------|---------------|-------------|
| 161           | 3.53        | 193           | 3.43        | 225           | 4.00        | 257           | 5.00        | 289           | 6.00        |
| 162           | 3.53        | 194           | 3.43        | 226           | 4.00        | 258           | 5.00        | 290           | 6.00        |
| 163           | 4.14        | 195           | 4.04        | 227           | 4.45        | 259           | 5.23        | 291           | 6.33        |
| 164           | 5.08        | 196           | 5.14        | 228           | 6.06        | 260           | 6.79        | 292           | 8.00        |
| 165           | 5.03        | 197           | 5.14        | 229           | 5.38        | 261           | 6.14        | 293           | 7.47        |
| 166           | 7.16        | 198           | 8.00        | 230           | 8.61        | 262           | 10.20       | 294           | 14.29       |
| 167           | 6.25        | 199           | 6.25        | 231           | 6.61        | 263           | 8.61        | 295           | 10.67       |
| 168           | 9.75        | 200           | 9.33        | 232           | 10.20       | 264           | 12.57       | 296           | 20.00       |
| 169           | 3.75        | 201           | 4.00        | 233           | 4.62        | 265           | 5.45        | 297           | 10.00       |
| 170           | 3.75        | 202           | 4.00        | 234           | 4.62        | 266           | 5.45        | 298           | 10.00       |
| 171           | 4.02        | 203           | 4.31        | 235           | 4.81        | 267           | 5.73        | 299           | 10.91       |
| 172           | 5.64        | 204           | 5.56        | 236           | 6.40        | 268           | 7.47        | 300           | 10.91       |
| 173           | 5.64        | 205           | 5.38        | 237           | 5.64        | 269           | 7.01        | 301           | 13.33       |
| 174           | 8.61        | 206           | 7.47        | 238           | 9.33        | 270           | 12.57       | 302           | 21.67       |
| 175           | 6.61        | 207           | 6.06        | 239           | 7.01        | 271           | 9.75        | 303           | 18.67       |
| 176           | 10.67       | 208           | 9.75        | 240           | 11.25       | 272           | 16.62       | 304           | 28.57       |
| 177           | 4.29        | 209           | 4.80        | 241           | 5.23        | 273           | 9.23        | 305           | 13.33       |
| 178           | 4.29        | 210           | 4.80        | 242           | 5.23        | 274           | 9.23        | 306           | 13.33       |
| 179           | 4.64        | 211           | 5.01        | 243           | 5.47        | 275           | 10.00       | 307           | 17.50       |
| 180           | 7.29        | 212           | 6.61        | 244           | 7.01        | 276           | 10.00       | 308           | 16.07       |
| 181           | 7.29        | 213           | 6.15        | 245           | 6.61        | 277           | 12.00       | 309           | 27.50       |
| 182           | 11.25       | 214           | 10.20       | 246           | 11.25       | 278           | 18.00       | 310           | 22.50       |
| 183           | 8.33        | 215           | 8.33        | 247           | 8.98        | 279           | 16.00       | 311           | 40.00       |
| 184           | 15.00       | 216           | 12.57       | 248           | 14.29       | 280           | 22.50       | 312           | 40.00       |
| 185           | 5.50        | 217           | 8.00        | 249           | 8.57        | 281           | 12.00       | 313           | 15.00       |
| 186           | 5.50        | 218           | 8.00        | 250           | 8.57        | 282           | 12.00       | 314           | 15.00       |
| 187           | 5.77        | 219           | 8.57        | 251           | 9.23        | 283           | 13.33       | 315           | 20.57       |
| 188           | 7.77        | 220           | 8.57        | 252           | 9.23        | 284           | 15.24       | 316           | 18.57       |
| 189           | 7.77        | 221           | 9.62        | 253           | 10.91       | 285           | 14.17       | 317           | 38.57       |
| 190           | 12.57       | 222           | 13.19       | 254           | 15.00       | 286           | 21.67       | 318           | 28.57       |
| 191           | 14.29       | 223           | 15.00       | 255           | 15.24       | 287           | 18.67       | 319           | 42.00       |
| 192           | 15.00       | 224           | 16.00       | 256           | 18.67       | 288           | 28.57       | 320           | 42.00       |

TABLE 2.A. (PAGE 1 OF 2)  
 ROUND TRIP TRAVEL SPEED FOR 'ON HIGHWAY'  
 LOGGING TRUCKS BY HAUL CLASS IN MILES/HOUR  
 LOADED / EMPTY

| HAUL<br>CLASS MPH | HAUL<br>CLASS MPH | HAUL<br>CLASS MPH | HAUL<br>CLASS MPH | HAUL<br>CLASS MPH |
|-------------------|-------------------|-------------------|-------------------|-------------------|
| 1 55/55           | 33 45/50          | 65 42/46          | 97 45/43          | 129 35/35         |
| 2 45/55           | 34 40/48          | 66 37/45          | 98 41/39          | 130 35/35         |
| 3 35/55           | 35 34/44          | 67 30/40          | 99 38/38          | 131 30/34         |
| 4 25/35           | 36 24/30          | 68 22/28          | 100 25/31         | 132 24/28         |
| 5 25/40           | 37 25/33          | 69 24/30          | 101 25/33         | 133 24/28         |
| 6 18/26           | 38 17/23          | 70 16/22          | 102 17/23         | 134 16/20         |
| 7 20/30           | 39 20/28          | 71 18/26          | 103 20/28         | 135 17/25         |
| 8 15/20           | 40 12/18          | 72 11/17          | 104 13/19         | 136 11/17         |
| 9 50/55           | 41 41/46          | 73 40/44          | 105 42/40         | 137 35/35         |
| 10 40/50          | 42 38/44          | 74 36/42          | 106 38/40         | 138 35/35         |
| 11 35/50          | 43 32/42          | 75 29/39          | 107 32/40         | 139 29/33         |
| 12 22/30          | 44 20/28          | 76 19/27          | 108 20/28         | 140 19/27         |
| 13 22/35          | 45 20/30          | 77 19/29          | 109 20/32         | 141 19/29         |
| 14 15/25          | 46 13/21          | 78 12/20          | 110 14/22         | 142 12/20         |
| 15 18/30          | 47 17/25          | 79 16/24          | 111 17/27         | 143 16/24         |
| 16 13/19          | 48 10/16          | 80 9/15           | 112 11/17         | 144 10/16         |
| 17 45/50          | 49 35/41          | 81 34/40          | 113 34/38         | 145 31/31         |
| 18 35/45          | 50 33/40          | 82 32/38          | 114 32/38         | 146 30/32         |
| 19 30/42          | 51 28/38          | 83 27/37          | 115 27/37         | 147 25/31         |
| 20 20/28          | 52 17/25          | 84 16/24          | 116 16/24         | 148 15/21         |
| 21 20/32          | 53 18/28          | 85 17/27          | 117 17/27         | 149 15/21         |
| 22 13/23          | 54 11/19          | 86 10/18          | 118 10/18         | 150 9/17          |
| 23 16/26          | 55 15/23          | 87 14/22          | 119 14/22         | 151 13/19         |
| 24 11/17          | 56 9/15           | 88 8/14           | 120 8/14          | 152 7/13          |
| 25 35/40          | 57 32/36          | 89 31/35          | 121 25/31         | 153 21/25         |
| 26 31/41          | 58 28/32          | 90 27/31          | 122 25/31         | 154 21/25         |
| 27 28/38          | 59 25/29          | 91 24/28          | 123 24/28         | 155 20/24         |
| 28 18/26          | 60 16/24          | 92 15/23          | 124 15/23         | 156 14/20         |
| 29 18/28          | 61 15/23          | 93 14/22          | 125 14/22         | 157 14/20         |
| 30 11/21          | 62 10/18          | 94 9/17           | 126 10/17         | 158 8/16          |
| 31 14/24          | 63 13/21          | 95 12/18          | 127 12/20         | 159 7/15          |
| 32 10/16          | 64 8/14           | 96 7/13           | 128 9/13          | 160 7/13          |

TABLE 2.A. (PAGE 2 OF 2)  
 ROUND TRIP TRAVEL SPEED FOR 'ON HIGHWAY'  
 LOGGING TRUCKS BY HAUL CLASS IN MILES/HOUR  
 LOADED / EMPTY

| HAUL<br>CLASS MPH | HAUL<br>CLASS MPH | HAUL<br>CLASS MPH | HAUL<br>CLASS MPH | HAUL<br>CLASS MPH |
|-------------------|-------------------|-------------------|-------------------|-------------------|
| 161 34/34         | 193 35/35         | 225 30/30         | 257 24/24         | 289 20/20         |
| 162 34/34         | 194 35/35         | 226 30/30         | 258 24/24         | 290 20/20         |
| 163 28/30         | 195 27/33         | 227 26/28         | 259 22/24         | 291 18/20         |
| 164 21/27         | 196 20/28         | 228 16/26         | 260 14/24         | 292 12/20         |
| 165 22/26         | 197 20/28         | 229 19/27         | 261 17/23         | 293 13/21         |
| 166 15/19         | 198 12/20         | 230 11/19         | 262 9/17          | 294 6/14          |
| 167 16/24         | 199 16/24         | 231 15/23         | 263 11/19         | 295 9/15          |
| 168 10/16         | 200 10/18         | 232 9/17          | 264 7/15          | 296 4/12          |
| 169 32/32         | 201 30/30         | 233 26/26         | 265 22/22         | 297 12/12         |
| 170 32/32         | 202 30/30         | 234 26/26         | 266 22/22         | 298 12/12         |
| 171 28/32         | 203 26/30         | 235 24/26         | 267 20/22         | 299 11/11         |
| 172 18/26         | 204 19/25         | 236 15/25         | 268 13/21         | 300 11/11         |
| 173 18/26         | 205 19/27         | 237 18/26         | 269 14/22         | 301 9/ 9          |
| 174 11/19         | 206 13/21         | 238 10/18         | 270 7/15          | 302 4/ 9          |
| 175 15/23         | 207 16/26         | 239 14/22         | 271 10/16         | 303 5/ 9          |
| 176 9/15          | 208 10/16         | 240 8/16          | 272 5/13          | 304 3/ 7          |
| 177 28/28         | 209 25/25         | 241 22/24         | 273 13/13         | 305 9/ 9          |
| 178 28/28         | 210 25/25         | 242 22/24         | 274 13/13         | 306 9/ 9          |
| 179 24/28         | 211 23/25         | 243 21/23         | 275 12/12         | 307 6/ 8          |
| 180 14/20         | 212 15/23         | 244 14/22         | 276 12/12         | 308 7/ 8          |
| 181 14/20         | 213 16/25         | 245 15/23         | 277 10/10         | 309 3/ 8          |
| 182 8/16          | 214 9/17          | 246 8/16          | 278 5/10          | 310 4/ 8          |
| 183 12/18         | 215 12/18         | 247 11/17         | 279 6/10          | 311 2/ 6          |
| 184 6/12          | 216 7/15          | 248 6/14          | 280 4/ 8          | 312 2/ 6          |
| 185 20/24         | 217 15/15         | 249 14/14         | 281 10/10         | 313 8/ 8          |
| 186 20/24         | 218 15/15         | 250 14/14         | 282 10/10         | 314 8/ 8          |
| 187 19/23         | 219 14/14         | 251 13/13         | 283 9/ 9          | 315 5/ 7          |
| 188 13/19         | 220 14/14         | 252 13/13         | 284 7/ 9          | 316 6/ 7          |
| 189 13/19         | 221 12/13         | 253 11/11         | 285 8/ 9          | 317 2/ 7          |
| 190 7/15          | 222 7/13          | 254 6/12          | 286 4/ 9          | 318 3/ 7          |
| 191 6/14          | 223 6/12          | 255 7/ 9          | 287 5/ 9          | 319 2/ 5          |
| 192 6/12          | 224 6/10          | 256 5/ 9          | 288 3/ 7          | 320 2/ 5          |

TABLE 3. (PAGE 1 OF 5)  
 ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| UNIT COST(\$/MBF/MILE) |        |        |       | UNIT COST(\$/MBF/MILE) |        |        |       |
|------------------------|--------|--------|-------|------------------------|--------|--------|-------|
| HAUL                   | 0-1    | 1.1-30 | 30.1+ | HAUL                   | 0-1    | 1.1-30 | 30.1+ |
| CLASS                  | MILES  | MILES  | MILES | CLASS                  | MILES  | MILES  | MILES |
| 1                      | .7273  | .1818  | .1091 | 33                     | .8444  | .2111  | .1267 |
| 2                      | .8081  | .2020  | .1212 | 34                     | .9167  | .2292  | .1375 |
| 3                      | .9351  | .2338  | .1403 | 35                     | 1.0428 | .2607  | .1564 |
| 4                      | 1.3714 | .3429  | .2057 | 36                     | 1.5000 | .3750  | .2250 |
| 5                      | 1.3000 | .3250  | .1950 | 37                     | 1.4061 | .3515  | .2109 |
| 6                      | 1.8803 | .4701  | .2821 | 38                     | 2.0460 | .5115  | .3069 |
| 7                      | 1.6667 | .4167  | .2500 | 39                     | 1.7143 | .4286  | .2571 |
| 8                      | 2.3333 | .5833  | .3500 | 40                     | 2.7778 | .6944  | .4167 |
| 9                      | .7636  | .1909  | .1145 | 41                     | .9226  | .2306  | .1384 |
| 10                     | .9000  | .2250  | .1350 | 42                     | .9809  | .2452  | .1471 |
| 11                     | .9714  | .2429  | .1457 | 43                     | 1.1012 | .2753  | .1652 |
| 12                     | 1.5758 | .3938  | .2364 | 44                     | 1.7143 | .4286  | .2571 |
| 13                     | 1.4805 | .3701  | .2221 | 45                     | 1.6667 | .4167  | .2500 |
| 14                     | 2.1333 | .5333  | .3200 | 46                     | 2.4908 | .6227  | .3736 |
| 15                     | 1.7778 | .4444  | .2667 | 47                     | 1.9765 | .4941  | .2965 |
| 16                     | 2.5911 | .6478  | .3887 | 48                     | 3.0000 | .8125  | .4875 |
| 17                     | .8444  | .2111  | .1267 | 49                     | 1.0592 | .2648  | .1589 |
| 18                     | 1.0159 | .2540  | .1524 | 50                     | 1.1061 | .2765  | .1659 |
| 19                     | 1.1429 | .2857  | .1714 | 51                     | 1.2406 | .3102  | .1861 |
| 20                     | 1.7143 | .4286  | .2571 | 52                     | 1.9765 | .4941  | .2965 |
| 21                     | 1.6250 | .4062  | .2437 | 53                     | 1.8254 | .4563  | .2738 |
| 22                     | 2.4080 | .6020  | .3612 | 54                     | 2.8708 | .7177  | .4306 |
| 23                     | 2.0192 | .5048  | .3029 | 55                     | 2.2029 | .5507  | .3304 |
| 24                     | 2.9947 | .7487  | .4492 | 56                     | 3.0000 | .8889  | .5333 |
| 25                     | 1.0714 | .2679  | .1607 | 57                     | 1.1806 | .2951  | .1771 |
| 26                     | 1.1330 | .2832  | .1699 | 58                     | 1.3393 | .3348  | .2009 |
| 27                     | 1.2406 | .3102  | .1861 | 59                     | 1.4897 | .3724  | .2234 |
| 28                     | 1.8803 | .4701  | .2821 | 60                     | 2.0833 | .5208  | .3125 |
| 29                     | 1.8254 | .4563  | .2738 | 61                     | 2.2029 | .5507  | .3304 |
| 30                     | 2.7706 | .6926  | .4156 | 62                     | 3.0000 | .7778  | .4667 |
| 31                     | 2.2619 | .5655  | .3393 | 63                     | 2.4908 | .6227  | .3736 |
| 32                     | 3.0000 | .8125  | .4875 | 64                     | 3.0000 | .9821  | .5893 |

TABLE 3. (PAGE 2 OF 5)  
 ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| UNIT COST (\$/MBF/MILE) |           |              |             | UNIT COST (\$/MBF/MILE) |           |              |             |
|-------------------------|-----------|--------------|-------------|-------------------------|-----------|--------------|-------------|
| HAUL CLASS              | 0-1 MILES | 1.1-30 MILES | 30.1+ MILES | HAUL CLASS              | 0-1 MILES | 1.1-30 MILES | 30.1+ MILES |
| 65                      | .9110     | .2277        | .1366       | 97                      | .9096     | .2274        | .1364       |
| 66                      | .9850     | .2462        | .1477       | 98                      | 1.0006    | .2502        | .1501       |
| 67                      | 1.1667    | .2917        | .1750       | 99                      | 1.0526    | .2632        | .1579       |
| 68                      | 1.6234    | .4058        | .2435       | 100                     | 1.4452    | .3613        | .2168       |
| 69                      | 1.5000    | .3750        | .2250       | 101                     | 1.4061    | .3515        | .2109       |
| 70                      | 2.1591    | .5398        | .3239       | 102                     | 2.0460    | .5115        | .3069       |
| 71                      | 1.8803    | .4701        | .2821       | 103                     | 1.7143    | .4286        | .2571       |
| 72                      | 2.9947    | .7487        | .4492       | 104                     | 2.5911    | .6478        | .3887       |
| 73                      | .9545     | .2386        | .1432       | 105                     | .9762     | .2440        | .1464       |
| 74                      | 1.0317    | .2579        | .1543       | 106                     | 1.0263    | .2566        | .1539       |
| 75                      | 1.2025    | .3006        | .1804       | 107                     | 1.1250    | .2812        | .1687       |
| 76                      | 1.7934    | .4483        | .2690       | 108                     | 1.7143    | .4286        | .2571       |
| 77                      | 1.7423    | .4356        | .2613       | 109                     | 1.6250    | .4062        | .2437       |
| 78                      | 2.6667    | .6667        | .4000       | 110                     | 2.3377    | .5844        | .3506       |
| 79                      | 2.0833    | .5208        | .3125       | 111                     | 1.9172    | .4793        | .2876       |
| 80                      | 3.0000    | .8889        | .5333       | 112                     | 2.9947    | .7487        | .4492       |
| 81                      | 1.0882    | .2721        | .1632       | 113                     | 1.1146    | .2786        | .1672       |
| 82                      | 1.1513    | .2878        | .1727       | 114                     | 1.1513    | .2878        | .1727       |
| 83                      | 1.2813    | .3203        | .1922       | 115                     | 1.2813    | .3203        | .1922       |
| 84                      | 2.0833    | .5208        | .3125       | 116                     | 2.0833    | .5208        | .3125       |
| 85                      | 1.9172    | .4793        | .2876       | 117                     | 1.9172    | .4793        | .2876       |
| 86                      | 3.0000    | .7778        | .4667       | 118                     | 3.0000    | .7778        | .4667       |
| 87                      | 2.3377    | .5844        | .3506       | 119                     | 2.3377    | .5844        | .3506       |
| 88                      | 3.0000    | .9821        | .5893       | 120                     | 3.0000    | .9821        | .5893       |
| 89                      | 1.2166    | .3041        | .1825       | 121                     | 1.4452    | .3613        | .2168       |
| 90                      | 1.3859    | .3465        | .2079       | 122                     | 1.4452    | .3613        | .2168       |
| 91                      | 1.5476    | .3869        | .2321       | 123                     | 1.5476    | .3869        | .2321       |
| 92                      | 2.2029    | .5507        | .3304       | 124                     | 2.2029    | .5507        | .3304       |
| 93                      | 2.3377    | .5844        | .3506       | 125                     | 2.3377    | .5844        | .3506       |
| 94                      | 3.0000    | .8497        | .5098       | 126                     | 3.0000    | .7941        | .4765       |
| 95                      | 2.7778    | .6944        | .4167       | 127                     | 2.6667    | .6667        | .4000       |
| 96                      | 3.0000    | 1.0989       | .6593       | 128                     | 3.0000    | .9402        | .5641       |

TABLE 3. (PAGE 3 OF 5)  
 ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| UNIT COST (\$/MBF/MILE) |        |        |       | UNIT COST (\$/MBF/MILE) |        |        |       |
|-------------------------|--------|--------|-------|-------------------------|--------|--------|-------|
| HAUL                    | 0-1    | 1.1-30 | 30.1+ | HAUL                    | 0-1    | 1.1-30 | 30.1+ |
| CLASS                   | MILES  | MILES  | MILES | CLASS                   | MILES  | MILES  | MILES |
| 129                     | 1.1429 | .2857  | .1714 | 161                     | 1.1765 | .2941  | .1765 |
| 130                     | 1.1429 | .2857  | .1714 | 162                     | 1.1765 | .2941  | .1765 |
| 131                     | 1.2549 | .3137  | .1882 | 163                     | 1.3810 | .3452  | .2071 |
| 132                     | 1.5476 | .3869  | .2321 | 164                     | 1.6931 | .4233  | .2540 |
| 133                     | 1.5476 | .3869  | .2321 | 165                     | 1.6783 | .4196  | .2517 |
| 134                     | 2.2500 | .5625  | .3375 | 166                     | 2.3860 | .5965  | .3579 |
| 135                     | 1.9765 | .4941  | .2965 | 167                     | 2.0833 | .5208  | .3125 |
| 136                     | 2.9447 | .7487  | .4492 | 168                     | 3.0000 | .8125  | .4875 |
| 137                     | 1.1429 | .2857  | .1714 | 169                     | 1.2500 | .3125  | .1875 |
| 138                     | 1.1429 | .2857  | .1714 | 170                     | 1.2500 | .3125  | .1875 |
| 139                     | 1.2957 | .3229  | .1944 | 171                     | 1.3393 | .3348  | .2009 |
| 140                     | 1.7934 | .4483  | .2690 | 172                     | 1.8903 | .4701  | .2821 |
| 141                     | 1.7423 | .4356  | .2613 | 173                     | 1.8803 | .4701  | .2821 |
| 142                     | 2.6667 | .6667  | .4000 | 174                     | 2.8708 | .7177  | .4306 |
| 143                     | 2.0833 | .5208  | .3125 | 175                     | 2.2029 | .5507  | .3404 |
| 144                     | 3.0000 | .8125  | .4875 | 176                     | 3.0000 | .8889  | .5333 |
| 145                     | 1.2903 | .3226  | .1935 | 177                     | 1.4286 | .3571  | .2143 |
| 146                     | 1.2917 | .3229  | .1937 | 178                     | 1.4286 | .3571  | .2143 |
| 147                     | 1.4452 | .3613  | .2168 | 179                     | 1.5476 | .3869  | .2321 |
| 148                     | 2.2857 | .5714  | .3429 | 180                     | 2.4286 | .6071  | .3643 |
| 149                     | 2.2857 | .5714  | .3429 | 181                     | 2.4286 | .6071  | .3643 |
| 150                     | 3.0000 | .8497  | .5098 | 182                     | 3.0000 | .9375  | .5625 |
| 151                     | 2.5911 | .6478  | .3887 | 183                     | 2.7778 | .6944  | .4167 |
| 152                     | 3.0000 | 1.0989 | .6593 | 184                     | 3.0000 | 1.2500 | .7500 |
| 153                     | 1.7524 | .4381  | .2629 | 185                     | 1.8333 | .4583  | .2750 |
| 154                     | 1.7524 | .4381  | .2629 | 186                     | 1.8333 | .4583  | .2750 |
| 155                     | 1.8333 | .4583  | .2750 | 187                     | 1.9222 | .4805  | .2883 |
| 156                     | 2.4286 | .6071  | .3643 | 188                     | 2.5911 | .6478  | .3887 |
| 157                     | 2.4286 | .6071  | .3643 | 189                     | 2.5911 | .6478  | .3887 |
| 158                     | 3.0000 | .9375  | .5625 | 190                     | 3.0000 | 1.0476 | .6286 |
| 159                     | 3.0000 | 1.0476 | .6286 | 191                     | 3.0000 | 1.1905 | .7143 |
| 160                     | 3.0000 | 1.0989 | .6593 | 192                     | 3.0000 | 1.2500 | .7500 |

TABLE 3. (PAGE 4 OF 5)  
 ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| UNIT COST (\$/MBF/MILE) |        |        |       | UNIT COST (\$/MBF/MILE) |        |        |       |
|-------------------------|--------|--------|-------|-------------------------|--------|--------|-------|
| HAUL                    | 0-1    | 1.1-30 | 30.1+ | HAUL                    | 0-1    | 1.1-30 | 30.1+ |
| CLASS                   | MILES  | MILES  | MILES | CLASS                   | MILES  | MILES  | MILES |
| 193                     | 1.1429 | .2857  | .1714 | 225                     | 1.3333 | .3333  | .2000 |
| 194                     | 1.1429 | .2857  | .1714 | 226                     | 1.3333 | .3333  | .2000 |
| 195                     | 1.3468 | .3367  | .2020 | 227                     | 1.4835 | .3709  | .2225 |
| 196                     | 1.7143 | .4286  | .2571 | 228                     | 2.0192 | .5048  | .3029 |
| 197                     | 1.7143 | .4286  | .2571 | 229                     | 1.7934 | .4483  | .2690 |
| 198                     | 2.6667 | .6667  | .4000 | 230                     | 2.8708 | .7177  | .4306 |
| 199                     | 2.0833 | .5208  | .3125 | 231                     | 2.2029 | .5507  | .3304 |
| 200                     | 3.0000 | .7778  | .4667 | 232                     | 3.0000 | .8497  | .5098 |
| 201                     | 1.3333 | .3333  | .2000 | 233                     | 1.5385 | .3846  | .2308 |
| 202                     | 1.3333 | .3333  | .2000 | 234                     | 1.5385 | .3846  | .2308 |
| 203                     | 1.4359 | .3590  | .2154 | 235                     | 1.6026 | .4006  | .2404 |
| 204                     | 1.8526 | .4632  | .2779 | 236                     | 2.1333 | .5333  | .3200 |
| 205                     | 1.7934 | .4483  | .2690 | 237                     | 1.8803 | .4701  | .2821 |
| 206                     | 2.4908 | .6227  | .3736 | 238                     | 3.0000 | .7778  | .4667 |
| 207                     | 2.0192 | .5048  | .3029 | 239                     | 2.3377 | .5844  | .3506 |
| 208                     | 3.0000 | .8125  | .4875 | 240                     | 3.0000 | .9375  | .5625 |
| 209                     | 1.6000 | .4000  | .2400 | 241                     | 1.7424 | .4356  | .2614 |
| 210                     | 1.6000 | .4000  | .2400 | 242                     | 1.7424 | .4356  | .2614 |
| 211                     | 1.6696 | .4174  | .2504 | 243                     | 1.8219 | .4555  | .2733 |
| 212                     | 2.2029 | .5507  | .3304 | 244                     | 2.3377 | .5844  | .3506 |
| 213                     | 2.0500 | .5125  | .3075 | 245                     | 2.2029 | .5507  | .3304 |
| 214                     | 3.0000 | .8497  | .5098 | 246                     | 3.0000 | .9375  | .5625 |
| 215                     | 2.7778 | .6944  | .4167 | 247                     | 2.9947 | .7487  | .4492 |
| 216                     | 3.0000 | 1.0476 | .6286 | 248                     | 3.0000 | 1.1905 | .7143 |
| 217                     | 2.6667 | .6667  | .4000 | 249                     | 2.8571 | .7143  | .4286 |
| 218                     | 2.6667 | .6667  | .4000 | 250                     | 2.8571 | .7143  | .4286 |
| 219                     | 2.8571 | .7143  | .4286 | 251                     | 3.0000 | .7692  | .4615 |
| 220                     | 2.8571 | .7143  | .4286 | 252                     | 3.0000 | .7692  | .4615 |
| 221                     | 3.0000 | .8013  | .4808 | 253                     | 3.0000 | .9091  | .5455 |
| 222                     | 3.0000 | 1.0989 | .6593 | 254                     | 3.0000 | 1.2500 | .7500 |
| 223                     | 3.0000 | 1.2500 | .7500 | 255                     | 3.0000 | 1.2698 | .7619 |
| 224                     | 3.0000 | 1.3333 | .8000 | 256                     | 3.1111 | 1.5556 | .9333 |

TABLE 3. (PAGE 5 OF 5)  
 ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| UNIT COST (\$/MBF/MILE) |        |        |        | UNIT COST (\$/MBF/MILE) |        |        |        |
|-------------------------|--------|--------|--------|-------------------------|--------|--------|--------|
| HAUL                    | 0-1    | 1.1-30 | 30.1+  | HAUL                    | 0-1    | 1.1-30 | 30.1+  |
| CLASS                   | MILES  | MILES  | MILES  | CLASS                   | MILES  | MILES  | MILES  |
| 257                     | 1.6667 | .4167  | .2500  | 289                     | 2.0000 | .5000  | .3000  |
| 258                     | 1.6667 | .4167  | .2500  | 290                     | 2.0000 | .5000  | .3000  |
| 259                     | 1.7424 | .4356  | .2614  | 291                     | 2.1111 | .5278  | .3167  |
| 260                     | 2.2619 | .5655  | .3393  | 292                     | 2.6667 | .6667  | .4000  |
| 261                     | 2.0460 | .5115  | .3069  | 293                     | 2.4908 | .6227  | .3736  |
| 262                     | 3.0000 | .8497  | .5098  | 294                     | 3.0000 | 1.1905 | .7143  |
| 263                     | 2.8708 | .7177  | .4306  | 295                     | 3.0000 | .8889  | .5333  |
| 264                     | 3.0000 | 1.0476 | .6286  | 296                     | 3.3333 | 1.6667 | 1.0000 |
| 265                     | 1.8182 | .4545  | .2727  | 297                     | 3.0000 | .8333  | .5000  |
| 266                     | 1.8182 | .4545  | .2727  | 298                     | 3.0000 | .8333  | .5000  |
| 267                     | 1.9091 | .4725  | .2864  | 299                     | 3.0000 | .9091  | .5455  |
| 268                     | 2.4908 | .6227  | .3756  | 300                     | 3.0000 | .9091  | .5455  |
| 269                     | 2.3377 | .5844  | .3500  | 301                     | 3.0000 | 1.1111 | .6667  |
| 270                     | 3.0000 | 1.0476 | .6286  | 302                     | 3.6111 | 1.8056 | 1.0833 |
| 271                     | 3.0000 | .8125  | .4875  | 303                     | 3.1111 | 1.5556 | .9333  |
| 272                     | 3.0000 | 1.3846 | .8308  | 304                     | 4.7619 | 2.3810 | 1.4286 |
| 273                     | 3.0000 | .7692  | .4615  | 305                     | 3.0000 | 1.1111 | .6667  |
| 274                     | 3.0000 | .7692  | .4615  | 306                     | 3.0000 | 1.1111 | .6667  |
| 275                     | 3.0000 | .8333  | .5000  | 307                     | 3.0000 | 1.4583 | .8750  |
| 276                     | 3.0000 | .8333  | .5000  | 308                     | 3.0000 | 1.3393 | .8036  |
| 277                     | 3.0000 | 1.0000 | .6000  | 309                     | 4.5833 | 2.2917 | 1.3750 |
| 278                     | 3.0000 | 1.5000 | .9000  | 310                     | 3.7500 | 1.8750 | 1.1250 |
| 279                     | 3.0000 | 1.3333 | .8000  | 311                     | 6.6667 | 3.3333 | 2.0000 |
| 280                     | 3.7500 | 1.8750 | 1.1250 | 312                     | 6.6667 | 3.3333 | 2.0000 |
| 281                     | 3.0000 | 1.0000 | .6000  | 313                     | 3.0000 | 1.2500 | .7500  |
| 282                     | 3.0000 | 1.0000 | .6000  | 314                     | 3.0000 | 1.2500 | .7500  |
| 283                     | 3.0000 | 1.1111 | .6667  | 315                     | 3.4286 | 1.7143 | 1.0286 |
| 284                     | 3.0000 | 1.2698 | .7619  | 316                     | 3.0952 | 1.5476 | .9286  |
| 285                     | 3.0000 | 1.1806 | .7083  | 317                     | 6.4286 | 3.2143 | 1.9286 |
| 286                     | 3.6111 | 1.8056 | 1.0833 | 318                     | 4.7619 | 2.3810 | 1.4286 |
| 287                     | 3.1111 | 1.5556 | .9333  | 319                     | 7.0000 | 3.5000 | 2.1000 |
| 288                     | 4.7619 | 2.3810 | 1.4286 | 320                     | 7.0000 | 3.5000 | 2.1000 |

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TABLE 3. (PAGE 1 OF 5)

ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| HAUL<br>CLASS | UNIT COST(\$/MBF/MILE) |                 |                | HAUL<br>CLASS | UNIT COST(\$/MBF/MILE) |                 |                |
|---------------|------------------------|-----------------|----------------|---------------|------------------------|-----------------|----------------|
|               | 0-1<br>MILES           | 1.1-30<br>MILES | 30.1+<br>MILES |               | 0-1<br>MILES           | 1.1-30<br>MILES | 30.1+<br>MILES |
| 1             | .7545                  | .2545           | .2164          | 33            | .7956                  | .2956           | .2512          |
| 2             | .7828                  | .2828           | .2404          | 34            | .8208                  | .3208           | .2727          |
| 3             | .8273                  | .3273           | .2782          | 35            | .8650                  | .3650           | .3102          |
| 4             | .9800                  | .4800           | .4080          | 36            | 1.0250                 | .5250           | .4462          |
| 5             | .9550                  | .4550           | .3867          | 37            | .9921                  | .4921           | .4183          |
| 6             | 1.1581                 | .6581           | .5594          | 38            | 1.2161                 | .7161           | .6087          |
| 7             | 1.0833                 | .5833           | .4958          | 39            | 1.1000                 | .6000           | .5100          |
| 8             | 1.3167                 | .8167           | .6942          | 40            | 1.4722                 | .9722           | .8264          |
| 9             | .7673                  | .2673           | .2272          | 41            | .8229                  | .3229           | .2745          |
| 10            | .8150                  | .3150           | .2677          | 42            | .8433                  | .3433           | .2918          |
| 11            | .8400                  | .3400           | .2890          | 43            | .8854                  | .3854           | .3276          |
| 12            | 1.0515                 | .5515           | .4688          | 44            | 1.1000                 | .6000           | .5100          |
| 13            | 1.0182                 | .5182           | .4405          | 45            | 1.0833                 | .5833           | .4958          |
| 14            | 1.2467                 | .7467           | .6347          | 46            | 1.3718                 | .8718           | .7410          |
| 15            | 1.1222                 | .6222           | .5289          | 47            | 1.1918                 | .6918           | .5880          |
| 16            | 1.4069                 | .9069           | .7709          | 48            | 1.6375                 | 1.1375          | .9669          |
| 17            | .7956                  | .2956           | .2512          | 49            | .8707                  | .3707           | .3151          |
| 18            | .8556                  | .3556           | .3022          | 50            | .8871                  | .3871           | .3291          |
| 19            | .9000                  | .4000           | .3400          | 51            | .9342                  | .4342           | .3691          |
| 20            | 1.1000                 | .6000           | .5100          | 52            | 1.1918                 | .6918           | .5880          |
| 21            | 1.0687                 | .5687           | .4834          | 53            | 1.1389                 | .6389           | .5431          |
| 22            | 1.3428                 | .8428           | .7164          | 54            | 1.5048                 | 1.0048          | .8541          |
| 23            | 1.2067                 | .7067           | .6007          | 55            | 1.2710                 | .7710           | .6554          |
| 24            | 1.5481                 | 1.0481          | .8909          | 56            | 1.7444                 | 1.2444          | 1.0578         |
| 25            | .8750                  | .3750           | .3187          | 57            | .9132                  | .4132           | .3512          |
| 26            | .8965                  | .3965           | .3371          | 58            | .9687                  | .4687           | .3984          |
| 27            | .9342                  | .4342           | .3691          | 59            | 1.0214                 | .5214           | .4432          |
| 28            | 1.1581                 | .6581           | .5594          | 60            | 1.2292                 | .7292           | .6198          |
| 29            | 1.1389                 | .6389           | .5431          | 61            | 1.2710                 | .7710           | .6554          |
| 30            | 1.4697                 | .9697           | .8242          | 62            | 1.5889                 | 1.0889          | .9256          |
| 31            | 1.2917                 | .7917           | .6729          | 63            | 1.3718                 | .8718           | .7410          |
| 32            | 1.6375                 | 1.1375          | .9669          | 64            | 1.8750                 | 1.3750          | 1.1687         |

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ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| UNIT COST (\$/MBF/MILE) |              |                 |                | UNIT COST (\$/MBF/MILE) |              |                 |                |
|-------------------------|--------------|-----------------|----------------|-------------------------|--------------|-----------------|----------------|
| HAUL<br>CLASS           | 0-1<br>MILES | 1.1-30<br>MILES | 30.1+<br>MILES | HAUL<br>CLASS           | 0-1<br>MILES | 1.1-30<br>MILES | 30.1+<br>MILES |
| 65                      | .8188        | .3188           | .2710          | 97                      | .8183        | .3183           | .2706          |
| 66                      | .8447        | .3447           | .2930          | 98                      | .8502        | .3502           | .2977          |
| 67                      | .9083        | .4083           | .3471          | 99                      | .8684        | .3684           | .3132          |
| 68                      | 1.0682       | .5682           | .4830          | 100                     | 1.0058       | .5058           | .4299          |
| 69                      | 1.0250       | .5250           | .4462          | 101                     | .9921        | .4921           | .4183          |
| 70                      | 1.2557       | .7557           | .6423          | 102                     | 1.2161       | .7161           | .6087          |
| 71                      | 1.1581       | .6581           | .5594          | 103                     | 1.1000       | .6000           | .5100          |
| 72                      | 1.5481       | 1.0481          | .8909          | 104                     | 1.4069       | .9069           | .7709          |
| 73                      | .8341        | .3341           | .2840          | 105                     | .8417        | .3417           | .2904          |
| 74                      | .8611        | .3611           | .3069          | 106                     | .8592        | .3592           | .3053          |
| 75                      | .9209        | .4209           | .3577          | 107                     | .8937        | .3937           | .3347          |
| 76                      | 1.1277       | .6277           | .5335          | 108                     | 1.1000       | .6000           | .5100          |
| 77                      | 1.1098       | .6098           | .5183          | 109                     | 1.0687       | .5687           | .4834          |
| 78                      | 1.4333       | .9333           | .7933          | 110                     | 1.3182       | .8182           | .6955          |
| 79                      | 1.2292       | .7292           | .6198          | 111                     | 1.1710       | .6710           | .5704          |
| 80                      | 1.7444       | 1.2444          | 1.0578         | 112                     | 1.5481       | 1.0481          | .8909          |
| 81                      | .8809        | .3809           | .3237          | 113                     | .8901        | .3901           | .3316          |
| 82                      | .9030        | .4030           | .3425          | 114                     | .9030        | .4030           | .3425          |
| 83                      | .9484        | .4484           | .3812          | 115                     | .9484        | .4484           | .3812          |
| 84                      | 1.2292       | .7292           | .6198          | 116                     | 1.2292       | .7292           | .6198          |
| 85                      | 1.1710       | .6710           | .5704          | 117                     | 1.1710       | .6710           | .5704          |
| 86                      | 1.5889       | 1.0889          | .9256          | 118                     | 1.5889       | 1.0889          | .9256          |
| 87                      | 1.3182       | .8182           | .6955          | 119                     | 1.3182       | .8182           | .6955          |
| 88                      | 1.8750       | 1.3750          | 1.1687         | 120                     | 1.8750       | 1.3750          | 1.1687         |
| 89                      | .9258        | .4258           | .3619          | 121                     | 1.0058       | .5058           | .4299          |
| 90                      | .9851        | .4851           | .4123          | 122                     | 1.0058       | .5058           | .4299          |
| 91                      | 1.0417       | .5417           | .4604          | 123                     | 1.0417       | .5417           | .4604          |
| 92                      | 1.2710       | .7710           | .6554          | 124                     | 1.2710       | .7710           | .6554          |
| 93                      | 1.3182       | .8182           | .6955          | 125                     | 1.3182       | .8182           | .6955          |
| 94                      | 1.6895       | 1.1895          | 1.0111         | 126                     | 1.6118       | 1.1118          | .9450          |
| 95                      | 1.4722       | .9722           | .8264          | 127                     | 1.4333       | .9333           | .7933          |
| 96                      | 2.0385       | 1.5385          | 1.3077         | 128                     | 1.8162       | 1.3162          | 1.1188         |

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## ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| HAUL<br>CLASS | UNIT COST(\$/MBF/MILE) |                 |                | HAUL<br>CLASS | UNIT COST(\$/MBF/MILE) |                 |                |
|---------------|------------------------|-----------------|----------------|---------------|------------------------|-----------------|----------------|
|               | 0-1<br>MILES           | 1.1-30<br>MILES | 30.1+<br>MILES |               | 0-1<br>MILES           | 1.1-30<br>MILES | 30.1+<br>MILES |
| 129           | .9000                  | .4000           | .3400          | 161           | .9118                  | .4118           | .3500          |
| 130           | .9000                  | .4000           | .3400          | 162           | .9118                  | .4118           | .3500          |
| 131           | .9392                  | .4392           | .3733          | 163           | .9833                  | .4833           | .4108          |
| 132           | 1.0417                 | .5417           | .4604          | 164           | 1.0926                 | .5926           | .5037          |
| 133           | 1.0417                 | .5417           | .4604          | 165           | 1.0874                 | .5874           | .4993          |
| 134           | 1.2875                 | .7875           | .6694          | 166           | 1.3351                 | .8351           | .7098          |
| 135           | 1.1918                 | .6918           | .5880          | 167           | 1.2292                 | .7292           | .6198          |
| 136           | 1.5481                 | 1.0481          | .8909          | 168           | 1.6375                 | 1.1375          | .9669          |
| 137           | .9000                  | .4000           | .3400          | 169           | .9375                  | .4375           | .3719          |
| 138           | .9000                  | .4000           | .3400          | 170           | .9375                  | .4375           | .3719          |
| 139           | .9535                  | .4535           | .3855          | 171           | .9687                  | .4687           | .3984          |
| 140           | 1.1277                 | .6277           | .5335          | 172           | 1.1581                 | .6581           | .5594          |
| 141           | 1.1098                 | .6098           | .5183          | 173           | 1.1581                 | .6581           | .5594          |
| 142           | 1.4333                 | .9333           | .7933          | 174           | 1.5048                 | 1.0048          | .8541          |
| 143           | 1.2292                 | .7292           | .6198          | 175           | 1.2710                 | .7710           | .6554          |
| 144           | 1.6375                 | 1.1375          | .9669          | 176           | 1.7444                 | 1.2444          | 1.0578         |
| 145           | .9516                  | .4516           | .3839          | 177           | 1.0000                 | .5000           | .4250          |
| 146           | .9521                  | .4521           | .3843          | 178           | 1.0000                 | .5000           | .4250          |
| 147           | 1.0058                 | .5058           | .4299          | 179           | 1.0417                 | .5417           | .4604          |
| 148           | 1.3000                 | .8000           | .6800          | 180           | 1.3500                 | .8500           | .7225          |
| 149           | 1.3000                 | .8000           | .6800          | 181           | 1.3500                 | .8500           | .7225          |
| 150           | 1.6895                 | 1.1895          | 1.0111         | 182           | 1.8125                 | 1.3125          | 1.1156         |
| 151           | 1.4069                 | .9069           | .7709          | 183           | 1.4722                 | .9722           | .8264          |
| 152           | 2.0385                 | 1.5385          | 1.3077         | 184           | 2.2500                 | 1.7500          | 1.4875         |
| 153           | 1.1133                 | .6133           | .5213          | 185           | 1.1417                 | .6417           | .5454          |
| 154           | 1.1133                 | .6133           | .5213          | 186           | 1.1417                 | .6417           | .5454          |
| 155           | 1.1417                 | .6417           | .5454          | 187           | 1.1728                 | .6728           | .5719          |
| 156           | 1.3500                 | .8500           | .7225          | 188           | 1.4069                 | .9069           | .7709          |
| 157           | 1.3500                 | .8500           | .7225          | 189           | 1.4069                 | .9069           | .7709          |
| 158           | 1.8125                 | 1.3125          | 1.1156         | 190           | 1.9667                 | 1.4667          | 1.2467         |
| 159           | 1.9667                 | 1.4667          | 1.2467         | 191           | 2.1667                 | 1.6667          | 1.4167         |
| 160           | 2.0385                 | 1.5385          | 1.3077         | 192           | 2.2500                 | 1.7500          | 1.4875         |

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TABLE 3. (PAGE 4 OF 5)

## ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| UNIT COST(\$/MBF/MILE) |              |                 |                | UNIT COST(\$/MBF/MILE) |              |                 |                |
|------------------------|--------------|-----------------|----------------|------------------------|--------------|-----------------|----------------|
| HAUL<br>CLASS          | 0-1<br>MILES | 1.1-30<br>MILES | 30.1+<br>MILES | HAUL<br>CLASS          | 0-1<br>MILES | 1.1-30<br>MILES | 30.1+<br>MILES |
| 193                    | .9000        | .4000           | .3400          | 225                    | .9667        | .4667           | .3967          |
| 194                    | .9000        | .4000           | .3400          | 226                    | .9667        | .4667           | .3967          |
| 195                    | .9714        | .4714           | .4007          | 227                    | 1.0192       | .5192           | .4413          |
| 196                    | 1.1000       | .6000           | .5100          | 228                    | 1.2067       | .7067           | .6007          |
| 197                    | 1.1000       | .6000           | .5100          | 229                    | 1.1277       | .6277           | .5335          |
| 198                    | 1.4333       | .9333           | .7933          | 230                    | 1.5048       | 1.0048          | .8541          |
| 199                    | 1.2292       | .7292           | .6198          | 231                    | 1.2710       | .7710           | .6554          |
| 200                    | 1.5889       | 1.0889          | .9256          | 232                    | 1.6895       | 1.1895          | 1.0111         |
| 201                    | .9667        | .4667           | .3967          | 233                    | 1.0385       | .5385           | .4577          |
| 202                    | .9667        | .4667           | .3967          | 234                    | 1.0385       | .5385           | .4577          |
| 203                    | 1.0026       | .5026           | .4272          | 235                    | 1.0609       | .5609           | .4768          |
| 204                    | 1.1484       | .6484           | .5512          | 236                    | 1.2467       | .7467           | .6347          |
| 205                    | 1.1277       | .6277           | .5335          | 237                    | 1.1581       | .6581           | .5594          |
| 206                    | 1.3718       | .8718           | .7410          | 238                    | 1.5889       | 1.0889          | .9256          |
| 207                    | 1.2067       | .7067           | .6007          | 239                    | 1.3182       | .8182           | .6955          |
| 208                    | 1.6375       | 1.1375          | .9669          | 240                    | 1.8125       | 1.3125          | 1.1156         |
| 209                    | 1.0600       | .5600           | .4760          | 241                    | 1.1098       | .6098           | .5184          |
| 210                    | 1.0600       | .5600           | .4760          | 242                    | 1.1098       | .6098           | .5184          |
| 211                    | 1.0843       | .5843           | .4967          | 243                    | 1.1377       | .6377           | .5420          |
| 212                    | 1.2710       | .7710           | .6554          | 244                    | 1.3182       | .8182           | .6955          |
| 213                    | 1.2175       | .7175           | .6099          | 245                    | 1.2710       | .7710           | .6554          |
| 214                    | 1.6895       | 1.1895          | 1.0111         | 246                    | 1.8125       | 1.3125          | 1.1156         |
| 215                    | 1.4722       | .9722           | .8264          | 247                    | 1.5481       | 1.0481          | .8909          |
| 216                    | 1.9667       | 1.4667          | 1.2467         | 248                    | 2.1667       | 1.6667          | 1.4167         |
| 217                    | 1.4333       | .9333           | .7933          | 249                    | 1.5000       | 1.0000          | .8500          |
| 218                    | 1.4333       | .9333           | .7933          | 250                    | 1.5000       | 1.0000          | .8500          |
| 219                    | 1.5000       | 1.0000          | .8500          | 251                    | 1.5769       | 1.0769          | .9154          |
| 220                    | 1.5000       | 1.0000          | .8500          | 252                    | 1.5769       | 1.0769          | .9154          |
| 221                    | 1.6218       | 1.1218          | .9535          | 253                    | 1.7727       | 1.2727          | 1.0818         |
| 222                    | 2.0385       | 1.5385          | 1.3077         | 254                    | 2.2500       | 1.7500          | 1.4875         |
| 223                    | 2.2500       | 1.7500          | 1.4875         | 255                    | 2.2778       | 1.7778          | 1.5111         |
| 224                    | 2.3667       | 1.8667          | 1.5867         | 256                    | 2.6778       | 2.1778          | 1.8511         |

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## ROUND TRIP HAUL COST FOR 'ON HIGHWAY' LOGGING TRUCKS

| HAUL<br>CLASS | UNIT COST (\$/MBF/MILE) |                 |                | HAUL<br>CLASS | UNIT COST (\$/MBF/MILE) |                 |                |
|---------------|-------------------------|-----------------|----------------|---------------|-------------------------|-----------------|----------------|
|               | 0-1<br>MILES            | 1.1-30<br>MILES | 30.1+<br>MILES |               | 0-1<br>MILES            | 1.1-30<br>MILES | 30.1+<br>MILES |
| 257           | 1.0833                  | .5833           | .4958          | 289           | 1.2000                  | .7000           | .5950          |
| 258           | 1.0833                  | .5833           | .4958          | 290           | 1.2000                  | .7000           | .5950          |
| 259           | 1.1098                  | .6098           | .5184          | 291           | 1.2389                  | .7389           | .6281          |
| 260           | 1.2917                  | .7917           | .6729          | 292           | 1.4333                  | .9333           | .7933          |
| 261           | 1.2161                  | .7161           | .6087          | 293           | 1.3718                  | .8718           | .7410          |
| 262           | 1.6895                  | 1.1895          | 1.0111         | 294           | 2.1667                  | 1.6667          | 1.4167         |
| 263           | 1.5048                  | 1.0048          | .8541          | 295           | 1.7444                  | 1.2444          | 1.0578         |
| 264           | 1.9667                  | 1.4667          | 1.2467         | 296           | 2.8333                  | 2.3333          | 1.9833         |
| 265           | 1.1364                  | .6364           | .5409          | 297           | 1.6667                  | 1.1667          | .9917          |
| 266           | 1.1364                  | .6364           | .5409          | 298           | 1.6667                  | 1.1667          | .9917          |
| 267           | 1.1682                  | .6682           | .5680          | 299           | 1.7727                  | 1.2727          | 1.0818         |
| 268           | 1.3718                  | .8718           | .7410          | 300           | 1.7727                  | 1.2727          | 1.0818         |
| 269           | 1.3182                  | .8182           | .6955          | 301           | 2.0556                  | 1.5556          | 1.3222         |
| 270           | 1.9667                  | 1.4667          | 1.2467         | 302           | 3.0278                  | 2.5278          | 2.1486         |
| 271           | 1.6375                  | 1.1375          | .9669          | 303           | 2.6778                  | 2.1778          | 1.8511         |
| 272           | 2.4385                  | 1.9385          | 1.6477         | 304           | 3.8333                  | 3.3333          | 2.8333         |
| 273           | 1.5769                  | 1.0769          | .9154          | 305           | 2.0556                  | 1.5556          | 1.3222         |
| 274           | 1.5769                  | 1.0769          | .9154          | 306           | 2.0556                  | 1.5556          | 1.3222         |
| 275           | 1.6667                  | 1.1667          | .9917          | 307           | 2.5417                  | 2.0417          | 1.7354         |
| 276           | 1.6667                  | 1.1667          | .9917          | 308           | 2.3750                  | 1.8750          | 1.5937         |
| 277           | 1.9000                  | 1.4000          | 1.1900         | 309           | 3.7083                  | 3.2083          | 2.7271         |
| 278           | 2.6000                  | 2.1000          | 1.7850         | 310           | 3.1250                  | 2.6250          | 2.2312         |
| 279           | 2.3667                  | 1.8667          | 1.5867         | 311           | 5.1667                  | 4.6667          | 3.9667         |
| 280           | 3.1250                  | 2.6250          | 2.2312         | 312           | 5.1667                  | 4.6667          | 3.9667         |
| 281           | 1.9000                  | 1.4000          | 1.1900         | 313           | 2.2500                  | 1.7500          | 1.4875         |
| 282           | 1.9000                  | 1.4000          | 1.1900         | 314           | 2.2500                  | 1.7500          | 1.4875         |
| 283           | 2.0556                  | 1.5556          | 1.3222         | 315           | 2.9000                  | 2.4000          | 2.0400         |
| 284           | 2.2778                  | 1.7778          | 1.5111         | 316           | 2.6667                  | 2.1667          | 1.8417         |
| 285           | 2.1528                  | 1.6528          | 1.4049         | 317           | 5.0000                  | 4.5000          | 3.8250         |
| 286           | 3.0278                  | 2.5278          | 2.1486         | 318           | 3.8333                  | 3.3333          | 2.8333         |
| 287           | 2.6778                  | 2.1778          | 1.8511         | 319           | 5.4000                  | 4.9000          | 4.1650         |
| 288           | 3.8333                  | 3.3333          | 2.8333         | 320           | 5.4000                  | 4.9000          | 4.1650         |

## ROAD MAINTENANCE

Road maintenance funding on Timber Sales falls into two categories, Forest Service Maintenance (Purchaser Deposits) and Purchaser Maintenance. Each is treated separately and uniquely. Table 4 costs should be used by Forests unless documented research indicates variance from that data. Tables 6 and 7 should be used in developing appraisals.

All items in Table 4 are broken down to more specific items in Table 4A. Not all items in Table 4A are required for all sale roads. Table 4A lists costs for timber volumes per mile and also rock volumes per mile. 20,000 cu. yd. for rock haul is equivalent to 5 MMBF for timber haul.

The following assumptions were used to establish Table 4A:

1. Equipment is of size required to do the job.
2. Qualified personnel are doing the job.
3. Operator \$10.10/hour.
4. Laborer \$8.23/hour.
5. 1,000 MBF = 4,000 C.Y. aggregate. (Timber and Aggregate Haul weight and wear equivalence)
6. Wear of aggregate materials is consistent with those listed in Table 5.
7. Calculation of surface stabilization costs.
  - a. Dust Oil - The following formula and example show how to calculate oiling costs:

Oil Cost = Application Rate x Road Width x Road Length x Cost Per Unit Application

Example:

Application Rate = R = 0.25 gallons/sq. yd.  
Road Width = W = 12 ft.  
Road Length = L = 1.0 miles  
Unit Cost = C = \$150/ton applied  
One Application lasts for 5 MMBF.

Oil Cost = RWLC =

$$\begin{aligned} \text{Oil Cost} &= \frac{\text{application}}{5,000 \text{ MBF}} \frac{0.25 \text{ gal.}}{\text{Yd.}^2} \frac{12 \text{ ft.} \times 1.0 \text{ miles}}{3 \text{ ft./yd.}} \frac{1760 \text{ yd.}}{\text{mile}} \frac{\text{ton}}{253 \text{ gal.}} \frac{\$150}{\text{td}} \\ &= \frac{\$0.21}{\text{MBF-Mile}} \end{aligned}$$

Scarification: Grader plus operator \$37/hour  
 @ 2 hours per mile lane = \$74

Watering:  $\frac{\$300}{\text{mile}}$

Scarification & Watering =  
 $\frac{\$74 + 300}{\text{mile}} \times \frac{\text{application}}{5,000 \text{ MBF}} = \frac{\$0.07}{\text{MBF-Mile}}$

Total Oiling Cost =  $\frac{\$0.21 + \$0.07}{\text{MBF-Mile}} = \frac{\$0.28}{\text{MBF-Mile}}$

b. Watering: If allowed,  
 5,000 to 7,000 gal./mile w/average haul of 30 miles  
 2 hours/mile @ \$30/hour = \$60/mile  
 Roadbed preparation \$74/mile  
 (One every 10 days \$7.40/mile)  
 Haul Costs \$60/mile

Total Costs  $\frac{\$127/\text{mile blading}}{\text{blading } 100 \text{ MBF}} = \frac{\$1.27}{\text{MBF-Mile}}$

Deposits (Forest Service Maintenance) and Purchaser road maintenance can be tabulated for appraisal purposes by use of Table 6. (For Surface Replacement Deposits - see C5.412). This can be used to facilitate the network analysis maintenance cost calculation for use in Table 7, NETWORK COST APPRAISAL.

Note: Required deposits (or deposits made under Cooperative Agreement authority, B4.225, at a later date) must include the Forest Service overhead assessment rate obtained from unit Administrative Officer. The charts and examples herein do not include such overhead assessments. ROAD MAINTENANCE WORKSHEET, Table 6, provides a column for this assessment rate factor.

TABLE 4. ROAD MAINTENANCE COSTS  
FOR "ON HIGHWAY" LOGGING TRUCKS  
(IN \$/MBF/TWO-WAY MILE\*)

(Revised May 1978)

| Average Number<br>of 5 MBF Loads Per<br>Day for Actual Day<br>Hauling |     |                       | R O A D   T Y P E |        |             |        |                  |        |
|-----------------------------------------------------------------------|-----|-----------------------|-------------------|--------|-------------|--------|------------------|--------|
|                                                                       |     |                       | Double Lane       |        | Single Lane |        |                  |        |
|                                                                       |     |                       | Paved             | Gravel | Paved       | Gravel | Spot<br>Surfaced | Native |
| -25                                                                   | *** | Surface Replacement   | .03               | .12    | .03         | .12    | .10              | .10    |
|                                                                       | **  | Ordinary              | .07               | .09    | .07         | .09    | .09              | .09    |
|                                                                       |     | Slope & Ditch Cleanup | .03               | .04    | .03         | .04    | .04              | .04    |
|                                                                       |     | Clearing & Shoulder   | .02               | .02    | .02         | .02    | .03              | .03    |
| -100                                                                  | *** | Surface Replacement   | .03               | .14    | .03         | .15    | .15              | .18    |
|                                                                       | **  | Ordinary              | .07               | .12    | .10         | .15    | .20              | .20    |
|                                                                       |     | Slope & Ditch Cleanup | .03               | .05    | .06         | .05    | .10              | .13    |
|                                                                       |     | Clearing & Shoulder   | .02               | .02    | .03         | .03    | .07              | .13    |
| 100                                                                   | *** | Surface Replacement   | .03               | .16    | .04         | .20    | .20              | .25    |
|                                                                       | **  | Ordinary              | .07               | .14    | .14         | .20    | .32              | .44    |
|                                                                       |     | Slope & Ditch Cleanup | .03               | .07    | .08         | .13    | .20              | .25    |
|                                                                       |     | Clearing & Shoulder   | .02               | .02    | .03         | .13    | .20              | .20    |

For different size loads and vehicles, use the following multipliers:

|                |        |
|----------------|--------|
| 5,000 GVW      | - .035 |
| 86,000 lb.     | - 1.46 |
| 96,000 lb.     | - 2.06 |
| 106,000 lb.    | - 2.84 |
| 116,000 lb.    | - 3.87 |
| Unloaded truck | - 0.11 |

\*The table cost figures include loaded truck one way and empty truck return.

\*Ordinary maintenance includes culvert cleaning.

\*To accurately calculate specific sale surface replacement costs, use Table 4A.

TABLE 4A. ROAD MAINTENANCE COSTS (ITEMIZED)  
FOR "ON HIGHWAY" LOGGING TRUCKS  
(IN \$/MBF/TWO-WAY MILE)

| Sale Maintenance Item                              | Average FS<br>Cost W/O Overhead |                    | Remarks                                                              |
|----------------------------------------------------|---------------------------------|--------------------|----------------------------------------------------------------------|
|                                                    | Timber<br>Haul<br>\$            | Rock<br>Haul<br>\$ |                                                                      |
|                                                    | MBF-Mile                        | C.Y.-Mile          |                                                                      |
| FOREST SERVICE MAINTENANCE (Required Deposits)     |                                 |                    |                                                                      |
| Maintenance Brushing                               | 0.02-0.05                       | 0.005-0.01         | Brush grown during sale.                                             |
| Slide Removal                                      | 0.02-0.05                       | 0.005-0.01         | 5-6 small slides per mile.                                           |
| Surface Rock Replacement                           | 0.16-0.41                       | 0.03-0.10          | See list of wear factors<br>for various material.                    |
| Bituminous Surface<br>Replacement                  | 0.33                            | 0.08               | 1/4-inch replacement per<br>10 MMBF or 40,000 C.Y.                   |
| Road Bank Stabilization                            | 0.03-0.06                       | 0.005-0.02         | Reseed and fertilize 4 to<br>10 feet to either side<br>road.         |
| Maintenance Dust Oil<br>(Collection)               | \$ .23-.40                      | 0.05-0.10          | 0.25 gallon/sq. yd.                                                  |
| PURCHASER MAINTENANCE                              |                                 |                    |                                                                      |
| Surface Maintenance                                | 0.09-0.22                       | 0.02-0.05          | 1 blading per 500 MMBF.                                              |
| Annual Maintenance<br>(Slope and Ditch<br>Cleanup) | 0.03-0.07                       | 0.005-0.02         | Downfall, slide removal,<br>shape ditch and road,<br>clean culverts. |
| Bituminous Annual Main-<br>tenance                 | 0.01-0.02                       | 0.003-0.005        | Ditch cleanup and culverts.                                          |
| Dust Abatement (Water<br>and Scarification)        | 0.58-2.30                       | 0.17-0.58          | Daily watering, 2 loads<br>@ average 50-day year.                    |
| Dust Oil Subsequent                                | 0.14-0.23                       | 0.04-0.06          | 0.20 gallons/sq. yd.                                                 |
| Initial Dust Oil                                   | -                               | -                  | 0.30 gallons/sq. yd.                                                 |

TABLE 5. AGGREGATE WEAR FACTORS

The following list indicates wearability factors for different aggregate materials:

| <u>Material</u>    |                          | <u>Wear Factor (WF)</u><br><u>Inches/MMBF</u> |
|--------------------|--------------------------|-----------------------------------------------|
| Crushed Aggregate: | Chert                    | 0.05                                          |
|                    | Limestone                | 0.05-0.07                                     |
|                    | River Rock               | 0.05                                          |
|                    | Alluvial & Conglomerate  | 0.05                                          |
|                    | Basalt                   | 0.07                                          |
|                    | Cinders                  | 0.10                                          |
| Pit Run:           | Cinders                  | 0.10                                          |
|                    | Alluvial                 | 0.05                                          |
|                    | Limestone                | 0.05-0.07                                     |
|                    | Decomposed Granite       | 0.07                                          |
| Native Soil:       | Sand                     | 0.20                                          |
|                    | Limestone                | 0.05                                          |
|                    | Decomposed Granite       | 0.07                                          |
|                    | Clayey Silt & Silty Clay | 0.15                                          |
|                    | Alluvial                 | 0.07                                          |
|                    | Silty or Clayey Gravel   | 0.07                                          |

TABLE 6. ROAD MAINTENANCE WORKSHEET

|               |                                                                                                      |                                   |  |         |  |
|---------------|------------------------------------------------------------------------------------------------------|-----------------------------------|--|---------|--|
| Project :     |                                                                                                      | Sale Volume :                     |  | Route : |  |
| Prepared By : |                                                                                                      | Date :                            |  |         |  |
| 1             | Road No.                                                                                             |                                   |  |         |  |
| 2             | Road Link                                                                                            |                                   |  |         |  |
| 3             | Link Miles                                                                                           |                                   |  |         |  |
| 4             | Road Status                                                                                          |                                   |  |         |  |
| 5             | Road Surface                                                                                         |                                   |  |         |  |
| 6             | Link Vol. (MBF)                                                                                      |                                   |  |         |  |
| 7             | Weighted Miles                                                                                       |                                   |  |         |  |
| 8             | CWFS (F.S. MTC.) \$/MBF/MILE<br>(Include Possible P&R Into<br>Unit Cost at Proposed Time<br>of Work) | A. Brushing                       |  |         |  |
|               |                                                                                                      | B. Slide Removal                  |  |         |  |
|               |                                                                                                      | C. Surface Rock Replacement       |  |         |  |
|               |                                                                                                      | D. Bituminous Surface Replacement |  |         |  |
|               |                                                                                                      | E. Stabilization                  |  |         |  |
|               |                                                                                                      | F. Dust Oil                       |  |         |  |
|               |                                                                                                      | Other                             |  |         |  |
| 9             | Subtotal CWFS MTC.<br>\$/MBF/MILE Per Link                                                           |                                   |  |         |  |
| 10            | District, SO, RO, WO<br>Overhead Factor                                                              |                                   |  |         |  |
| 11            | Total CWFS MTC.<br>\$/MBF/MILE Per Link                                                              |                                   |  |         |  |
| 12            | PURCHASER MTC. \$/MBF/MILE                                                                           | G. Surface MTC.                   |  |         |  |
|               |                                                                                                      | H. Annual MTC.                    |  |         |  |
|               |                                                                                                      | I. Annual Bituminous MTC.         |  |         |  |
|               |                                                                                                      | J. Dust Abatement (Water)         |  |         |  |
|               |                                                                                                      | K. Dust Abatement (Oil)           |  |         |  |
|               |                                                                                                      | Other                             |  |         |  |
| 13            | Total Purchaser MTC.<br>\$/MBF/MILE Per Link                                                         |                                   |  |         |  |
| 14            | Total MTC. \$/MBF                                                                                    |                                   |  |         |  |

Approved : \_\_\_\_\_ Date : \_\_\_\_\_

## INSTRUCTIONS FOR TABLE 6

Column

- 1 Road Number as listed in the Transportation System Inventory.
- 2 Insert node numbers of each end of road segment (link) from numbered road network.
- 3 Length in miles of road segment (link) listed in column 2.
- 4 Current road facility; proposed new construction, reconstruction, or reshaping.
- 5 Road surface type from Table 1, column 2.
- 6 Volume of timber (or equivalent rock volume) to be hauled over link.
- 7 Weighted miles is equivalent to the volume to be hauled over the link (column 6) divided by the total sale volume and multiplied by the link miles (column 3).  

$$\frac{\text{column 6}}{\text{sale vol.}} \times \text{column 3} = \text{weighted miles}$$
- 8 Maintenance deposits from Purchaser for Forest Service maintenance. Sub-columns A through F show a breakdown of maintenance items from Table 4A adjusted to planned date of work. CWFS is abbreviated for co-op with Forest Service.
- 9 Sum of maintenance items A through other in column 8.
- 10 Combined GA for District, SO, RO, and WO (one factor adjusted to proposed work or collection schedule).
- 11 Column 9 times column 10.
- 12 Maintenance items to be performed by the Purchaser. Sub-columns G through K show a breakdown of maintenance items from Table 4A.
- 13 Sum of items G through other in column 12.
- 14 Sum of column 11 and column 13 times column 7.

(Haul, Delay, Const./Reconst./Reshaping, MTC.)

Project : \_\_\_\_\_ Sale Volume : \_\_\_\_\_ Route : \_\_\_\_\_

Prepared By : \_\_\_\_\_ Date : \_\_\_\_\_

[illegible]

**Col. 21 X Col. 27 = Total Road Transportation Cost**

X = \$

## INSTRUCTIONS FOR TABLE 7

COLUMN

- 1 Road Number as listed in the Transportation System Inventory.
- 2 Insert node numbers of each end of road segment (link) from numbered road network.
- 3 Length in miles of road segment (link) listed in column 2.
- 4 Current road facility: proposed new construction, reconstruction, or reshaping.
- 5 Road surface type from Table 1, column 2.
- 6 Horizontal alignment classification from Table 1, column 3.
- 7 Average road grade of road segment (link) that corresponds to road grade columns listed in Table 1.
- 8 Haul Class Number as determined from Table 1.
- 9 Volume of timber (or equivalent rock volume) to be hauled over link.
- 10 Weighted miles is equivalent to the volume to be hauled over the link (column 9) divided by the total sale volume and multiplied by the link miles (column 3)

$$\frac{\text{column 9}}{\text{sale vol.}} \times \text{column 3} = \text{weighted miles}$$

- 11-13 Costs from Table 3 used to calculate haul costs in column 14.
- 14 Sum of column 11 multiplied by the one (first) mile of the network plus column 12 multiplied by the network miles between 1 and 30 plus column 13 multiplied by the network miles over 30.
- 15 Construction/Reconstruction/Reshaping cost per road link.
- 16 Column 15 divided by total sale volume in MBF.
- 17 Column 15 divided by column 9. (Shows the economic feasibility of each link).
- 18 Maintenance cost (\$/MBF) from column 14 Table 6.
- 19 Sum of column 14 plus column 16 plus column 18.
- 20 Sum of column 3.
- 21 Sum of column 9. (Might not equal sale volume due to sale layout and/or transportation system network).
- 22 Sum of column 14.
- 23 Sum of column 15.
- 24 Sum of column 16. (Should equal column 23 divided by sale volume in MBF).
- 25 Delay cost equals delay time per MBF (from Figure E-4) multiplied by operator plus rental rate cost per minute.

$$\frac{\text{delay time in minutes}}{\text{MBF}} \times \frac{\text{cost-\$}}{\text{minute}} = \text{delay cost-\$/MBF}$$

- 26 Sum of column 18.
- 27 Sum of column 19 (Should also equal the sum of column 22, 24, 25 and 26).